VersaLASER™

Models VL-200 & VL-300

Advanced Driver Computerized Controls

Printer Driver and Graphics Software
Installation, Setup, Operation Instructions and
Material Power Settings Guide
Using Microsoft XP

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Section 1

Printer Driver Installation

The ULS printer driver allows Microsoft Windows based graphics software programs to interface with the laser system. Before continuing with the printer driver installation and the operation of your laser system, a complete and thorough understanding of how your computer, the Windows operating system, and your graphics software work is essential. Also, we recommend that you read your laser system's operations manual before proceeding. It contains important information concerning safety and the proper use of the equipment as well as defining much of terminology used in this manual.

Windows XP (ONLY)

- Power ON your PC. If your PC is already ON, close all programs.
- Click *Start*, and then click *Printers and Faxes*.
- Click *Add Printer*. When the *Add Printer Wizard* dialog box appears click *Next*.
- Choose *Local Printer attached to this computer* and deselect (uncheck) *Automatically detect and install my Plug & Play Printer* and then click *Next.*
- *Use the following Port (LPT1)* should already be selected. We recommend the use of this port. If the system is connected to a different port, choose the correct port from the dropdown list and click *Next*.
- Click *Have Disk*, insert the printer driver CD-ROM, which can be found in a sleeve attached to the rear cover of this manual, and then click *Browse*. Locate the ULS2000.inf file in the \WIN2000_XP_Vxxxx\ folder (where xxxx is the version number), click *Open*, and then click *OK*.
- When the list of printers appears, choose your model from the list. If you are unsure of your model's name, turn on the laser system and the model name will appear in the control panel display while the system is initializing or the model name can also be found engraved on the serial tag found on the backside of the machine. Click *Next*.
- The *Name your printer* dialog box will appear. You may rename the printer if you like, however, we suggest that you leave the name unchanged or simply add a word or two after the name (keeping the name, including blank spaces, under 31 characters). Choose to whether or not you would like it to be your default printer and then click *Next*.
- The *Printer Sharing* dialog box will appear. Unless you are planning to share the laser system on a network, select *Do not share this printer*. Please consult your network administrator if you would like to share the laser system on your network.
- Select *No* to *Do you want to print a test page* and then click *Next*.
- Click *Finish* to close the wizard. When the Windows Logo Testing warning appears click *Continue Anyway*.
- After the driver finishes installation, store your printer driver disk in a safe place for future reference.

Section 2

Graphics Software Setup

Choosing the right graphics software program to run the laser system is essential for maximum usage and control of the laser system. Not all software can be used to run the laser system because many have limitations. Because you may be using word processing software to output to your laser printer does not mean you should use it to output to your laser engraving system. Setting up you software correctly is essential to running the laser system properly.

The following examples assume that you are configuring the software for a VL-200. If you have a VL-300, substitute the correct maximum page size:

VL-300 = 24 x 12 inches (609.6 x 304.8mm)

NOTE: We have provided specific instructions for setting up CorelDRAW 12,X3 AutoCAD 2000i/2002/2004, and Adobe Illustrator CS in order for these programs to work well with the laser system. You will find them at the end of this section.

General Software Setup

There are many software programs that you can purchase off-the-shelf that will work with the laser system. Some of them can access more features of the laser system than others may. Whichever program you choose, it must be set up to work with the laser system otherwise unexpected results may occur. Use the following **GENERAL** guidelines when configuring your software program.

Page Setup

To properly generate and position artwork, most graphics software will permit the customization of the page size and orientation. Set the page orientation, in the graphics software to Landscape, and the page size to match your maximum engraving area of your Platform. The driver's orientation and page size MUST then be set to match these specifications EXACTLY, otherwise the artwork may not print correctly. When setting page orientation and driver orientation to Landscape mode, the laser system will operate in the horizontal direction, left to right. If page orientation and driver orientation is set to Portrait mode, the laser system will operate in the vertical direction, front to back. The laser system is designed to operate best in the Landscape mode and this orientation is highly recommended. The page size may also be reduced to match the size of the engraving material, but remember to adjust the page size in the driver's to correspond to the graphics software's page size. Note that in production situations it is often more efficient to leave the page size at its maximum page size and engrave or cut more than one object at a time. This is accomplished by duplicating the image on screen as many times as necessary to fill up the entire page.

Ruler Setup

Usually the graphics software will provide on-screen rulers, which can be configured to match the rulers in the laser system. Using rulers in the software and matching them with the ones provided in the laser system gives the ability to correctly align the graphic on the screen with the material in the laser system. For now, consider that the laser system's origin is fixed in the upper left corner of the engraving area and cannot be altered. Later on you will learn how to relocate the origin. But for right now, change the ruler position on screen to match the laser system with the origin (0,0) in the upper left corner. It is also possible to use a page size smaller than the maximum engraving area. For example, if you desire an 8-inch (203.2 mm) x 10-inch (254 mm) page size, set this page size in the graphics software as well as in the printer driver. The laser system will automatically move the engraving area to the origin so place the object all the way up into the left-hand corner against the rulers in the laser system.

Power Control through Color Selection

The laser system allows the use of 8 different colors to access 8 different power settings when cutting and engraving. The printer driver controls this feature. When using this power change feature with driver, the colors that are used MUST exactly match the colors listed in the driver. The colors are black, red, green, yellow, blue, magenta, cyan, and orange. Some programs will provide these basic colors pre-defined and other programs may require the creation of each of the colors by defining them in RGB. If you are using CorelDRAW we have made our own custom palette and placed the file on the printer driver disk. Please refer to the software setup instructions for your specific version of CorelDRAW. If you are using other graphics software and need to mix your own colors, use the chart below to create them.

COLOR	RED	GREEN	BLUE
BLACK	0	0	0
RED	255	0	0
GREEN	0	255	0
YELLOW	255	255	0
BLUE	0	0	255
MAGENTA	255	0	255
CYAN	0	255	255
ORANGE	255	102	0

If using a color other than the exact colors listed above, the driver will attempt to match it to a color in the driver that it most closely resembles. The driver will then use that color's power setting and apply a halftone pattern to represent the original color's shade. For example, if using a color like pink to fill a rectangle, the driver takes a reading of the percentage of different colors used to create that color and will use the power setting assigned to one of the eight colors of the driver that it most closely resembles. It might be expected that the driver will use the power setting assigned to the color red but instead the driver may choose the magenta setting and halftone the rectangle as a representation of the pink color's lighter shade. To prevent the incorrect assignment of laser power, be sure to use the right colors. If using graphics with colors other than the eight listed above or to simplify the assignment of power settings, try using the Clipart Mode feature in the driver. This feature will cause the system to only use the power setting assigned to the color black and halftone all of the other colors.

Outlines and Fills

The driver distinguishes between raster mode (engraving) and vector mode (cutting) by the type of graphic artwork being used. Basically, all graphics other than outlines of very thin line widths will be interpreted as engraved images and the raster mode will be used for output. If laser cutting is desired, set the line thickness of the lines that are drawn in the graphics software to .001 inches (.025 mm) or the smallest possible line thickness that is available. The printer driver will interpret these objects as vectors and will cut them out providing that your software has the capability of vector output. Basically, all software programs have the ability to provide raster output. However, not all programs have the ability to provide vector output even if you set the line width to the smallest thickness possible. Check with Software Anomalies section in the back of this manual for software that can vector output. The use of color fills or bitmaps will cause the laser system to engrave. The combination of engraving and cutting is available in most graphics software. We suggest that when combining engraving and cutting objects, use different colors for the fills and outlines since engraving requires different power settings than cutting objects. One thing to keep in mind when creating cutting objects is that if the outline thickness is set too thick, the driver might interpret the outline as a filled object and will engrave the outline instead of cutting. This might be desirable if engraving thick outlines is necessary. The outline thickness at which the driver will interpret cut lines as filled objects is dependent on the software used. Usually, any line thickness .008 inches (.2 mm) or greater will engrave. The only way to determine the cross over point for line thickness is to experiment with different line widths. Software programs that do not have outline capabilities definitely will not have the ability to cut.

Image Processing Order

When cutting or engraving a graphic image, the laser system will perform all engraving first, and then proceed to vector cutting. Raster engraving will proceed in the exact order of the colors listed in the driver. For example, all black filled objects will engrave first, then all red filled objects, then all green filled objects and so on. When all engraved objects have been completed, the laser system will proceed to vector cut any outlines present in the artwork. Vector output order is dependent on your operating system, printer driver version, and your software. Refer to the printer driver controls for more details.

Overlapping Fills

If the artwork created has overlapping filled areas, the driver will automatically filter these fills to prevent the overlapped area from being engraved twice. This is similar to color separation in the printing industry. The entire filled area of the object on top will be engraved and only the visible part of the underlying filled area will be engraved. The final result is a what-you-see-is-what-you-get output. In this way the color white can be used as an effective drawing tool. Since the laser system will not engrave the color white (this is the background color), it can be used to block out the undesired engraving areas of filled regions and/or bitmaps. However, you cannot use a white fill to cover an outline, the outline will vector cut even though you cannot see it on screen.

Overlapping Outlines

The driver does not filter outlines that overlap each other. If placing one outline one on top of another, both outlines will be cut by the laser system. This is a useful feature that will allow deeper cutting by passing the laser over a single outline path twice or more. To take advantage of this feature, duplicate the outline on top of itself.

Hidden Vector Lines in Artwork

The driver does not automatically filter out outlines that are overlapped by engraved objects such as fills. If there are filled objects with some hidden outlines underneath, the laser system will then engrave out the fill and cut the hidden outline on top of the fill. This is a common occurrence when using pre-drawn clipart designed for laser printers. To prevent this from happening, turn on the Clipart Mode feature in the driver. This feature disables the cutting mode and converts all visible outlines to engraved objects and ignores all hidden outlines.

Speed Optimizing

It is advantageous to engrave an object in its longest direction because total engraving time will be reduced when the motion system has to make fewer stops and starts. If the engraving object is longer than it is tall, rotating the graphic 90 degrees and placing the material in the laser system sideways can achieve a greater engraving speed. Be aware that some graphics programs do not allow the rotation of bitmaps. In this case, it may be necessary to use a bitmap image processing software to first rotate the bitmap before importing the bitmap into the graphics program. If the artwork contains engraved objects of the same color with a great deal of space between them in the engraving direction, processing time can be longer since the laser must make long strokes to engrave both objects at the same time. To reduce engraving time in cases like these, use different colors for each of the objects but assign the same power setting to both colors. This will cause the laser to engrave one object at a time, skipping over all blank space, which in many cases will reduce engraving time. On the other hand, if the objects are relatively close together in the engraving direction, then leave them the same color because it will be quicker to engrave them both at the same time. Experiment with these techniques to optimize the speed of engraving.

Bitmapped / Scanned Images

There are primarily three types of bitmaps available. They are monochrome (black and white), grayscale, and color. Bitmaps are patterns of dots (pixels) blended to form pictures. Scanning artwork into a computer through a scanner creates most bitmaps. Drawing them in a bitmap image-processing program creates others.

The laser system can print all three types of bitmaps providing that either the driver or the bitmap image-processing program converts the grayscale and/or color bitmaps into a monochrome bitmap. Essentially, the laser system is a monochromatic printer, either it fires the beam to burn a dot or it does not fire the beam to leave an empty dot on the material.

There are several different bitmap storage formats available: TIF, JPG, BMP, PCX, and others. The format makes no difference to the laser system. The difference in formats involves how they are stored on your computer's hard disk. Bitmaps cannot be edited in most graphics software. Some basic functions such as cropping, scaling, or mirroring might be possible but it is usually necessary to use a bitmap image processing software to perform a dot by dot editing, rotation, or scaling of the bitmap.

Monochrome Bitmaps

If you scan the image in monochrome (black and white) mode, set your scanner to at least 600 DPI. The higher the DPI, the smoother the image will be. Scanning monochrome images at 300 DPI is the minimum recommended resolution but scanning them at 600 DPI will provide a significant improvement in the image quality. Clean it up in your bitmap image-processing program and save it to your hard disk. You can now either print the image directly from your bitmap image processing program, or import the bitmap into a graphics program and print it from there. Monochrome bitmaps are engraved in the same manner as black filled text. The black area will turn the laser on and the white area turns the laser off.

Grayscale Bitmaps

When scanning image in the grayscale mode, you should scan the image at no more than 300 DPI. Scanning at a higher DPI does not improve image quality but it consumes more memory and will take longer to print. Grayscale images cannot be printed directly to the laser system. Since the laser system actually works like a black and white printer, grayscale images must be converted into black and white images. To do this, either the driver will do it automatically or you can convert the grayscale image to a black and white image in your bitmap image-processing program.

The two, primary grayscale image conversion techniques are Halftone or Error Diffusion. The printer driver can print either one and it is selected in the driver under the "Graphics" tab. Please refer to the section on the printer driver for more details on how to set these parameters. Since the driver has a fixed method of conversion, you may want to experiment by using your bitmap image-processing program to make the conversion. These software programs usually have more options for controlling the size, angle, shape, and the amount of black and white dots (pixels) created when converting the image. Experiment with all of the controls to see which looks the best. Big dots look good on some materials and small dots look better on others. Once the image is converted by your program, save it and either print it directly from that program or import it into your graphics program and print it from there. Essentially, a Halftone image and an Error Diffusion image are actually both monochrome images and can be treated as such. If you decide not convert the grayscale image to a monochrome image in your bitmap image editing program, then the driver will do it automatically and will use settings based on the Resolution settings in the driver.

Color Bitmaps

The printer driver handles color bitmaps the same as grayscale bitmaps. Since color bitmaps use more memory, they are unnecessary and are therefore NOT recommended, however, you can still use them.

Encapsulated Postscript (EPS) Images

Bitmap images cannot be cut by the laser system only engraved. The only way to have the laser system cut out or vector a bitmap is to first convert it to a vector file format such as an EPS. Raster to vector conversion programs are available that trace the bitmap (this only works well with monochrome bitmaps) and creates a separate EPS vector file. These EPS files can then be imported into the graphics program and printed out from there. Since tracing programs have many adjustments, some practice with them is necessary to produce desirable results.

The laser system does not support Encapsulated PostScript (EPS) printing directly. EPS files can only be edited and printed if they are first imported into a graphics program. However, since EPS files support engraving and cutting objects, they are therefore useful for transferring artwork from one graphics program to another. Once an EPS file has been imported into a graphics program, the objects can be outlined, stretched, rotated, mirrored, filled with different colors, or anything else desired just as long as your graphics software can edit EPS images. Be careful when using EPS files in layout software as opposed to true graphics software. Layout software may allow the placement of EPS files in the artwork but may not actually import and convert the EPS file to a useful format for the printer driver and therefore may not print correctly. Please refer to your graphics software's documentation on whether or not it can edit and print EPS images to a non-Postscript printer.

Postscript (PS) Images

The laser system is NOT a postscript device. This means that postscript fills, postscript textures, and especially POSTSCRIPT FONTS WILL NOT be able to print to the laser system. Sometimes using Adobe Type Manager (ATM) will allow some postscript fonts to print correctly but most of the time does not work properly.

Helpful Tip

If you are having any problems printing a font and you cannot figure out what is going on, select the font and "convert to curves" or "convert to paths" in your graphics software. This will convert the font into a bitmapped image and will print correctly to the laser system. Refer to your graphics software on how to convert fonts. However, postscript textures and postscript fills cannot be converted and will not print to the laser system.

Specific Software Setup Instructions

Some graphics software programs require a special setup procedure in order for the software to function correctly with the ULS printer driver. In the following pages you will find setup instructions for the most popular software programs that our customers use. If you are having trouble with other software programs not included in this document, you may want to switch to one of them. As a reminder, ULS provides no warranties whatsoever on any software used in connection with a ULS Laser Engraving System, express or implied. Neither does it guarantee software compatibility with any off-the-shelf software package or any software program that has not been written by ULS.

CorelDRAW12

1. Using Windows Explorer, locate the file named “VersaLASER.CPL”, on the VersaLASER Installation CD, and copy this file over to the C C:\Program Files\Corel\Corel Graphics 12\Languages\EN\Custom Data\Palettes folder.
2. While still in Explorer, locate a file named “corelapp.ini” located in the C:\Program Files\Corel\Graphics12\Config folder. Double-click on the file it will open up in Notepad. Scroll down past the semi-colons to the [Config] header. Then scroll down 31 lines to the line that reads “Fontrasterizer=1”. Change the 1 to a 0 (this is a zero, not an o), save the file, and exit Notepad.
3. Open CorelDRAW12 and start a new graphic.
4. In the menu bar, click on “Window”, then “Color Palettes”, and then click “None”. Once again click “Window”, then “Color Palettes”, and then “Open Palette”. In the pop-up box, double-click on "VersaLASER.CPL" which allows it to appear on the right side of the screen.
5. On the property bar, click on the landscape orientation (the sideways rectangle). Enter the page width of 16 inches (406.4mm) (model VL-200) or 24 inches (609.6mm) (model VL-300) and height of 12 inches (304.8mm).
6. The rulers on screen need to match the rulers in the VersaLASER. Adjust the ruler's vertical origin by double-clicking directly on the vertical (side) ruler. The “Options” dialog box will appear. In the vertical origin box, type in 12 inches (304.8mm). Click OK
7. Set the default value for line width and color of the graphic objects, by clicking the outline tool and then the outline pen dialog in the flyout. With “Graphic” being the only selection checked, click “OK”. Click the down arrow in the Color dropdown box to expand the list and click on the color red. Click the down arrow in the “Width” dropdown box and click “Hairline”. The units can be “inches”, “millimeters” or anything else you prefer. Click “OK to close the Outline Pen dialog box.
8. In the top menu, click “Tools, then click “Color Management”. Click on the down arrow to expand the “Style” dropdown list. Click “Color Management Off”, and then click “OK”.
9. Finally, at the top of the screen, click on “Tools”, then “Options”, then “Document”, and then select “Save Options as Defaults for New Documents”. Make sure **ALL** the options listed are **CHECKED** then click “OK”.
10. The setup defaults for CorelDRAW12 are now complete. Whenever you start a new document, all of the default settings that we had setup will automatically apply to the new document.

Remove the VersaLASER Installation CD-ROM from your CD-ROM drive and store it either back into the pocket of the rear cover of the manual or in a safe place.

CorelDRAW X3

1. Make sure that you have installed all Service Releases and software patches from Microsoft. For Windows 2000, install Service Pack 3. If you are reading this document from the ULS Windows Printer Driver CD, as a service to you, you can find the file on this CD. There is an update available for Windows XP included in the ULS Windows Printer Driver CD, but it is not mandatory that you install it. For the latest releases, check Microsoft's website, www.microsoft.com. Please contact Microsoft if you have any questions regarding these upgrades. ULS is not responsible for any problems as a result from the usage of these patches.
2. If you have not already done so, install CorelDraw on your computer, but do not open it yet.
3. It is important that your version of CorelDraw is updated with the latest patches and service releases. For the latest patches and updates go to CorelDraw's website, www.corel.com. As of the date of this publication there are no updates available for CorelDraw X3. Be sure to check for any updates from time to time to keep your version up to speed. Please contact CorelDraw if you have any questions regarding these upgrades. ULS is not responsible for any problems as a result from the usage of these patches.
4. The ULS Windows Printer Driver must be loaded before continuing. Please refer to the Computerized Controls manual on how to install the driver. If you have already installed the printer driver, you will need to re-insert the ULS Printer Driver Disk back into your CD drive at this time.
5. Using Windows Explorer, locate the file named "ULS.CPL" and "ULS.PAL" on the ULS Windows Printer Driver CD, and copy these files over to the C:\Program Files\Corel\Corel Graphics SUITE X3 (13)\Languages\EN\Custom Data\Palettes folder. **Note: ULS.CPL may not show up with a .CPL file extension. It may be listed as ULS with "Control panel extension" shown as a detail. If you own a VersaLASER the name of the file is VersaLASER.CPL.**
6. Open CorelDraw and start a new graphic.
7. In the main menu at the top of the screen, click on "Window", then "Color Palettes", and then click on "None". Once again click on "Window", then "Color Palettes", and then click on "Open Palette". After the "Open Palette" pop-up box appears, double-click on "ULS.CPL". The color palette will now appear on the right side of the screen. **Note: You can use either the ULS.CPL palette or the ULS.PAL palette, however, to use the ULS.PAL palette you must first select the PAL file type in the open palette screen.**
8. On the property bar, click on the landscape orientation (the sideways rectangle). If you would like the drawing units in metric, choose millimeters from the drop down list. Now type in the page width and height that matches your laser platform.
9. We now need to adjust the vertical ruler, on the left side of the screen, to match the rulers in the laser system. To do this, we need to adjust the ruler's vertical origin. Double-click directly on the vertical (side) ruler. The "Options" dialog box will appear. In the vertical origin box, type in the same height value as you did when you set up the page height in the previous step. For example, 12 inches for an M-300 machine. If you would like the scale to be displayed in tenths, choose "10 per Tick" in the "Tick Division" drop-down list box.
10. While still in the "Options" dialog box, double-click on "Global" to expand the list. Double-click on "Printing" to expand the list. Now click on "Driver Compatibility". Make sure that the laser system's name is displayed in the printer drop-down list. In the settings specific for this driver dialog box, make sure that **ALL** the check boxes are **UNCHECKED**. Now click on "OK" to close the "Options" dialog box.
11. The next step is to set the default value for the line width and color when drawing graphic objects. To do this, click on the outline tool, then the outline pen dialog in the flyout. With "Graphic" being the only one selected, click "OK". Click the down arrow in the Color dropdown box to expand the list and click on the color red. Click the down arrow in the "Width" dropdown box to expand the list and click "Hairline". The units can be "Inches", "millimeters" or anything else you prefer. Click "OK to close the Outline Pen dialog box.
12. In the top menu, click "**Tools**", and then click "**Color Management".** Click on the down arrow to expand the **"Settings"** dropdown list. Click **"Color Management Off**", and then click "OK".
13. Finally, at the top of the screen, click on "**Tools**", then "**Save settings as Defaults**".
14. The setup defaults for CorelDRAW X3 are now complete. Whenever you start a new document, all of the default settings that we had setup will automatically apply to the new document.

AutoCAD Version 2000i, 2002 and 2004 for Windows XP

NOTE: AutoCAD version 2000 is not compatible with ULS laser systems. You must upgrade to version 2000i or higher. Also, we recommend installing ULS printer driver version 1.07F or higher.

1. Make sure the ULS Printer driver is installed prior to setting up AutoCAD.
2. If AutoCAD is already installed and you are just upgrading ULS printer drivers:
   - Close all open programs.
   - In Windows, Click Start>Printers & Faxes.
   - Delete ALL ULS drivers from the Printers (Printers and Faxes) folder.
   - With the Printers and Faxes folder still open, click File>Server Properties>Drivers and remove ALL ULS printer drivers from the list. Close Printers & Faxes.
   - Using Windows Explorer, search for all files and folders with a .pc3 extension then delete all ULS Printer pc3 files (i.e. M-360.pc3).
   - Next, search for files with a .pmp extension and delete all ULS Printer .pmp files (i.e. M-360.pmp).
   - Reboot the PC.
3. Start AutoCAD and open a new drawing.
4. Click File>Plotter Manager, and double-click Add a Plotter Wizard. If the Autodesk Hardcopy System window appears, select the version of AutoCAD you are using, and then click Continue.
5. Click Next. Select System Printer, and then click Next.
6. Select the appropriate ULS Printer Driver, and then click Next.
7. **DO NOT** click the Import file button, simply click Next.
8. You may edit the plotter name, if desired, and then click Next.
9. Click on Modify Standard Paper Sizes (Printable Area) in the Device and Document Settings Tab window, and then click the Modify button. Change **ALL** margins to 0.00, and then click Next.
10. Edit the PMP file name if you desire then click Next. **DO NOT** click the Print a Test Page button, click Finish. Click OK to exit the Plotter Configuration Editor window and then click Finish.
11. Click File>Page Setup, and then select the Plotter Configuration name, pc3 name (not the driver) from the dropdown list.
12. If you would like to change the drivers settings, click the Properties button, then click the Custom Properties button. Make your changes and then click OK and then OK again.
13. Click New to create a new Plot Style table to set your pen widths. As a default, the ULS print driver produces vector output when pen widths are set to 0.001 inches (0.025 mm). If the pen widths are set between 0.002 – 0.008 inches (0.050 – 0.20 mm), then the ULS print driver may or may not convert the lines to raster images – this will depend on the image being plotted. Therefore it is recommended that for colors requiring vector output, set the pen widths to 0.001 inches (0.025 mm), and for colors requiring raster output, set pen widths greater than 0.008 inches (0.20 mm). So now, select Start from scratch, and then click Next. Enter a name and then click Next. Click the Plot Style Table Editor button. Click Color 1, hold the shift key on your keyboard and click colors 2 through 7. You can only use colors 1 through 7 with the ULS printer driver. With all 7 colors highlighted, click the Edit Lineweights button and then select the units desired. Add a lineweight of 0.001 inches (0.025 mm) to the Value column by clicking on Edit Lineweight and entering 0.001 (or 0.025 for metric settings). Click OK, click Save & Close, and then click Finish.
14. Click the Layout Settings tab and set the Plot Scale to 1:1.
15. AutoCAD is not set up properly to work with the ULS printer driver.

Adobe Illustrator CS for Windows XP

Adobe Illustrator CS, in combination with the new ULS printer driver version 1.07F or later, is now capable of both raster and vector output as well as full-field engraving capability. The following procedure assumes that you are familiar with the use and operation of Windows 200 or XP, and Adobe Illustrator CS.

Procedure

1. Close all Windows programs.
2. Upgrade to Adobe Illustrator CS but do not launch it yet.
3. Upgrade to ULS printer driver version 1.07F or later.
4. Set your Windows default printer to the ULS printer driver.
5. Launch Adobe Illustrator CS and start a new graphic.
6. You will now need to set the Page Setup, in Adobe, to the largest square page that is equal to the width of your laser systems field. For example, if your laser system has a 24 x 12 inch field, then set the page setup in Adobe to 24 x 24 inch Portrait mode (not Landscape). If you laser system has a 16x12 inch field, set the page setup in Adobe to 16 x 16 Portrait.
7. Now, place your graphics ONLY within the top portion of your page in Adobe. Don't use the bottom portion that extends below the physical size of the engraving area of your machine. Since your laser system truly doesn't have a usable area as big as the page size you created, the only way to make Adobe work is to trick it into thinking it is outputting to a larger, square-fielded, device.
8. If you would like vector output, in Adobe, set your stroke weight to either .001 inches or .1 points. You will have to type in this setting because it is not available from the dropdown list.

Section 3

Printer Driver Controls

This section describes the use of each of the features of the printer driver.

Definitions and Terminology

Vector Graphic: An image generated from mathematical descriptions that determine the position, length, and direction in which lines are drawn. Vector graphics are composed of fills and/or outlines.

Fill: A color, bitmap, fountain, or pattern applied to the interior area of a vector graphic.

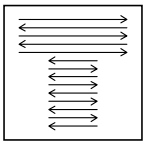
Outline: The line that defines the shape of a vector graphic.

Bitmap: An image composed of grids of pixels or dots.

Motion System: The mechanical/electrical system that delivers the laser beam by moving the focusing lens directly above the application material.

Laser Beam Delivery Method (Mode): Three distinct ways the laser system can deliver the laser beam to the application material called raster engraving, vector marking, and vector cutting.

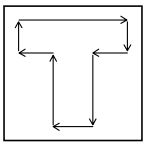
Raster: The process where the laser beam makes a series of bi-directional, horizontal scan lines to produce an image. Fills and Bitmaps are automatically raster engraved by the laser system.



Vector: The process where the laser beam follows the path of the outline (if present) of the graphic.

Marking: Setting the laser power low enough to only penetrate the surface of the material.

Cutting: Setting the laser power high enough to cut all the way through the material (if the material can be cut).



NOTE: When adjusting the printer driver settings, it is highly recommended that you practice engraving or cutting on a scrap portion of that material in case the settings need to be re-adjusted to obtain the desired results.

Laser Settings Tab

Pen Mode

The driver uses the word “PEN” because the laser system works similar to the operation of a pen plotter output device. A pen plotter physically selects a colored pen that matches the same colored objects in your graphic, called “color mapping”, and draws the graphic, on paper, in that color. The laser system, however, applies a Mode, % Power, % Speed, PPI, and Gas Assist (computer controlled air assist models only) setting to the individually colored objects in your graphic. Up to eight (8) sets of user-adjustable parameters, which control laser beam delivery to your application material, can be “mapped” to the respectively colored filled or outlined objects in your graphic.

NOTE: Black and white, grayscale, and color bitmaps are all mapped to the black color’s settings.

Clicking the square button toggles through the following laser beam delivery modes for the each of the eight respective pen colors.

- ***RAST/VECT*** (default) rasters fills and vector marks or cuts proper outlines.
- ***RAST*** rasters all fills **AND** outlines regardless of outline thickness.
- ***VECT*** only vector marks or cuts proper outlines. It will skip all fills and will skip all outlines with line weights thicker than a hairline.
- ***SKIP*** ignores all fills and outlines.

Color, Power, Speed, and PPI

To change the % Power, % Speed, and/or PPI of a color, position the mouse arrow on the color name and click once. This will highlight the color’s parameters and will allow the changing of the settings by using the scroll bars or by typing in each setting in the appropriate control box. It is possible to click on more than one color to set them to the same setting at the same time. IN the Windows 95/98/ME driver, PPI is not adjustable unless the Use Default PPI (500) is NOT selected.

% Power

Available settings are from 0 to 100%. This setting is directly related to how deep the engraving will be. The higher the setting, the deeper it engraves, marks, or cuts, and vice-versa.

% Speed

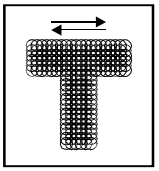
Available settings are from 0 to 100%. This setting determines the maximum rate of travel of the motion system. Actual engraving time (throughput) is not only dependent on the % Speed setting, but is also dependent on the size and the placement of the graphic in the engraving field. The motion system will accelerate/decelerate as fast as it can up to the chosen speed. If the motion system cannot achieve the chosen speed based on the size of the graphic or graphical placement in the field it will automatically adjust its speed internally to the maximum speed it can achieve. This is evident when you see the motion system automatically slow down while cutting curves or circles as opposed to straight lines. Automatic proportional pulsing (see PPI) of the laser beam will ensure that there is no difference in the depth of cut from straight lines to curves. Remember that depending on the graphic and your chosen settings, increasing or decreasing the speed setting will not necessarily process the file faster or slower, respectively. We will discuss how to optimize the throughput of the system later in this manual.

% Power and % Speed work together in determining how deep the engraving or cutting will be. Higher power and slower speeds produce deeper results. Lower power and higher speeds produce shallower results.

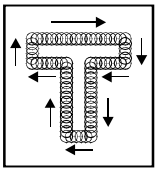
NOTE: 100% raster speed is different than 100% vector speed. Due to the inertia of the X-axis arm, movements in the Y-direction, and also depending on which model you have, vector speeds will range from one-third to one-half the maximum raster speed.

PPI

Available settings are 10 to 1000. The laser beam is always pulsed and never "on" continuously even though it may appear that way. The PPI setting indicates how many laser pulses, per linear inch, the laser cartridge will emit. The pulsing of the laser beam is electronically linked to the motion system. These pulses will always fire, equally spaced, from one to the next, regardless of changes in speed.



In raster mode, the laser pulses are applied in bi-directional, horizontal scan lines just like a dot matrix printer. If you set the PPI to 500 and use the standard focusing lens (2.0") which has a laser spot size of five thousandths of an inch (.005"), pulses will fire every .002 inches (500 PPI), which will produce pulse overlap. Raising the PPI higher, such as 1000, the pulses will overlap more whereas lowering the PPI to something like 150 will spread the pulses out far enough where they may not overlap at all. When raster engraving filled objects, it is advisable to use a PPI setting of 500 or higher. If using less, the image resolution of the engraving is reduced. In some rare cases, using less than 500 PPI may produce better results.



In vector mode, laser pulsing follows the path of the outline of the object. Imagine the laser system working like a sewing machine where the stitching always remains consistent whether you sew fast, slow, or around curves. The setting you use will be application material dependent. Using less than 150 PPI may result in the pulses being spread so far apart that they may or may not touch one another. Perforated paper has this characteristic. Higher PPI settings may cause more of a melting or burning effect on the edges whereas lower PPI settings may reduce the burning, melting, or charring, but may result in a serrated or perforated-looking edge. Increasing or decreasing the PPI setting does not affect engraving speed, only the frequency of the pulses.

Set Button

After making % Power, % Speed, and PPI adjustments, you must click the Set button to register the change. If you do not click on Set, but click the OK button instead, the settings will revert back to the previous settings.

?

This selection, located in each tab, opens the printer driver's help screens.

Save

By clicking Save, the "Save Engraving Setup" dialog box will appear and will allow you to enter in a file name. All settings will be stored in this file that has a ".LAS" extension. DO NOT rename the extension; the driver will not recognize the file as a laser settings file if it does not have the ".LAS" extension name. These files can be stored in any directory on your hard drive or floppy disks and you can have as many setting files as your disks can hold.

Load

To recall printer driver settings that have been previously saved, click on the "Load" button and choose the desired .LAS settings file. The settings that are currently on screen will be replaced by the settings from the .LAS file. You may abort this change by clicking Cancel; clicking OK will approve the change.

Default

This button will reset the driver settings to the originally installed values.

Print Mode

In this dropdown list, you can choose from 4 different printing modes, Normal (default), Clipart, 3D, and Rubber Stamp.

Clipart Mode

This control simulates laser printer output and is very useful if using a drawing with many colors, shades of gray, or many outlines. It is recommended to turn this control ON when using DRAWN clipart because there may be some underlying cutting lines hiding behind filled areas. Having this control ON gives a what-you-see-is-what-you-get output very similar to laser printer output. The entire drawing will be raster engraved, including all outlines, and only the Black color setting is used. The driver automatically turns OFF its color-mapping feature and all colors are engraved as different shades of gray, represented by a halftone pattern. The type of halftone pattern is based upon the "Quality" setting of the driver the same way grayscale bitmaps are interpreted. Since clipart images use a wide variety of colors, shades, and outlines, the only effective way of engraving these images is to have this control turned ON. Clipart mode also provides greater compatibility with Windows software that does not work well with vector devices such as the laser system. Do not activate this control when printing photographs or bitmapped images; use it **ONLY** with **DRAWN** clipart.

3D

There are two ways to use this feature. The first method is used produce an engraving that has a contoured depth, giving it a three dimensional feel. It is used in combination with grayscale bitmaps by automatically assigning laser power levels to the shades of gray of the bitmap **WITHOUT** converting the image to a halftone. These power settings are based off the setting you entered for the color black, in the printer driver. The darkest shades of gray (black) will be assigned the value of the setting for the black color. The lightest shade of gray (white) will automatically be assigned a 0% power. All other shades of gray that fall between black and white will automatically be assigned an appropriate power level that matches the darkness of the color. The engraving will appear "3D" because the depth of the engraving will vary according to the image. Sometimes it takes several passes to create enough relief in the engraving to get the desired results.

Special 3D software is required to produce the type of grayscale images that are compatible with this mode. You cannot simply use ANY grayscale bitmap to produce a "3D" effect. Please contact our Applications Department for the latest 3D software recommendations.

The second way to use the 3D feature is to engrave any photograph, lightly onto the surface of hard materials such as black marble, anodized aluminum, painted brass, micro-surfaced engravers plastic, etc., to produce unbelievable photographic quality. Using the appropriate materials and settings, the end result is an engraving that looks more like a photograph than a halftoned or diffusion dithered image does. To use the 3D feature in this method you must first set up a few things.

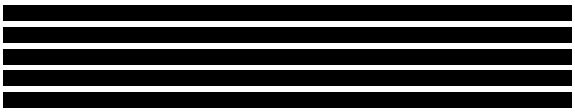
Choose Your Material

The best material to use is one that has the highest contrast such as black anodized aluminum, black marble, or black cored engravers plastic with a white micro surfaced coating. While other materials may work ok, they might not produce the highest quality.

Establishing Nominal Power

Choose your %Speed and you Image Density settings. Set the PPI to 1000 but don't set the %Power setting just yet. The objective is to use the **LOWEST** %Power setting that produces the most contrast such as the whitest (as in black anodized aluminum) or the darkest (as in black cored engravers plastic with a white micro surfaced coating) results. This is what we call the "nominal" power setting. Over-powering the material will produce poor results.

In your graphics software, create a series of 5 rectangles that are about ¼ inch high and 6 inches wide as in the following diagram:



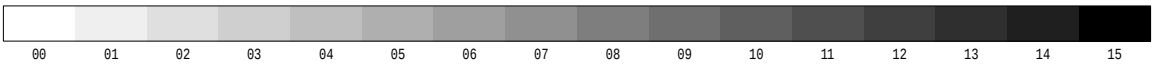
Starting with the top rectangle set the power setting to a value that you know will be too low. For example, engrave the first rectangle at 5% power, increasing the power for each subsequent rectangle 5% finishing the series off at 25% power and note the results. Choose the rectangle that uses the lowest %Power setting to achieve the most contrast. If 25% is not enough power, then engrave the rectangles once again, this time starting at 25% and incrementing by 5% and so on.

In this particular example, we'll say that 20% power looks over-burned but 15% appears under-burned. Since the material may be sensitive to small power changes, you may need to narrow it down a bit further. Engrave a new series of rectangles, but this time start the top rectangle at 15% then add 1% for the next rectangle, and so forth, until you find the best setting between 15% and 20%.

The setting that produces the highest contrast using the least amount of %Power is called the nominal power setting.

Engraving a Calibration Scale

Now that you have established the nominal power setting, you will need to engrave a grayscale calibration scale. You can create one of your own or use the one provided for you which can be found on the printer driver disk called "Calibration Scale.CDR". This is a CorelDRAW 8 file so using versions 8 and higher will open the file. The scale looks like this:



Each rectangle is .5 inches wide and .25 inches tall. Each successive shade of gray is incremented by 16 levels starting at 0 and ending at 255. The numbers below the scale are there as a reference to the 16 levels of power control (explained later) and do not need to be engraved if you do not want to.

You can also load a custom grayscale color palette into your CorelDRAW program. This file can also be found on your driver disk and is named "ULS photo.cpl". Use this palette if you want to create your own calibration scale.

Engrave the calibration scale, onto your material, using the nominal power setting you established earlier. Compare it to the actual calibration scale that you see on screen or in this manual. If the response of your material to the laser beam was perfectly linear, then the result should look exactly like the calibration scale. Most likely you will find that several rectangles appear to have the same appearance of shading. The objective would be to engrave the calibration scale and produce a result that would appear as if each rectangle would have its own distinguishable level of gray, starting from white all the way to black. To help you achieve those results, the printer driver gives you the ability to calibrate the power level of each one of the rectangles. To access the feature, click on the "Configure" button.

Configure Button

When you click this button, the ULS 3D Power Calibration screen will appear. Notice that there are 16 slider bars representing the 16 shades of gray of the calibration scale. The 00 and the 15 are not adjustable as they represent white and black. The 14 other ones can be adjusted. The objective is to go back and forth between adjusting the corresponding slider bars and re-engraving the calibration scale until you can duplicate the appearance of the calibration scale as best as you can. As you are progressing **MAKE SURE YOU KEEP SAVING YOUR SETTINGS IN AN LAS FILE** just in case your computer crashes, etc. This is a lengthy procedure so you do not want to have to do it twice.

Once you have duplicated the Calibration Scale onto your material, calibration is now complete. You only need to do this calibration one time for each material you intend on using to produce photographs.

NOTE: If you are using a type of material that becomes lighter when you engrave, such as black marble, you will need to invert the photograph first (make a negative image), in your photo editing software, otherwise when you engrave the image, it will appear like a negative image.

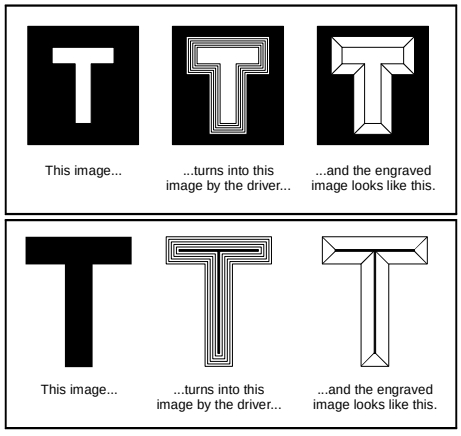
APPLY Button
Click this button to enable the settings that you just set.

CLOSE Button
This closes the 3D Power Calibration settings window and cancels any changes you made to the scale if you didn't click the APPLY button.

DEFAULTS Button
Applies the factory default settings to the 3D Power Calibration settings

Rubber Stamp

This mode causes a "shouldering" effect when raster engraving rubber stamp material or any other material that requires a "shouldered" engraving. The effect looks as if the laser beam engraved the material on an angle, but in actuality it is the precise control of laser power that creates this appearance. This is a "raster only" feature that only works with black colored graphics and uses the power setting of the black color in the printer driver. Vectors are processed normally and can be used for vector engraving or cutting by assigning any of the seven other printer driver colors to the outline desired.


This image...
...turns into this image by the driver...
...and the engraved image looks like this.
This image...
...turns into this image by the driver...
...and the engraved image looks like this.

To obtain a "raised" engraving such as a rubber stamp, simply create a "negative" graphic so that the background is black and the text or graphic objects are white. This way, the background engraves and the text or objects remain untouched, producing a "pyramid" effect.

To obtain a “chiseled” or “sunken” engraving, create a “positive” graphic so that the background is white and the text or objects are black. This way, the text or graphic engraves and the background remains untouched, producing a “chiseled” effect.

Configure Button

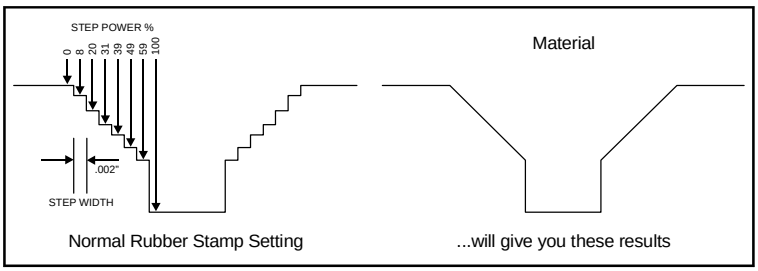
Selecting it brings up a pop-up window so you can choose from the following settings:

Taper Selection
Choose from various types of shoulder angles. Experiment with each setting and note the result.

Invert Page
This converts all black objects into white and all white objects into black for the ENTIRE PAGE. This is very useful for engraving a full sheet of rubber stamps.

Mirror Page
This mirrors the ENTIRE PAGE from left to right (horizontally). It will not mirror individual objects or selections. This is very useful for engraving full sheets rubber stamps because the graphics on screen are non-mirrored and can be proof read easily.

Power
Notice that when you click on different Taper Selections, that the power table changes. This is because the laser applies power in different profiles to produce different styles of taper. You will notice that you cannot adjust the pre-defined Taper, however, if you would like to create a custom taper of your own, first select the Taper Selection that you would like to start with and then click the “NEW” button. This will copy the taper as a “Custom Shoulder” that you can rename by typing a new name in the dialog box and clicking “Rename”. You can also adjust the profile however you desire. Each slider bar controls the lasers power for that step. The numbers at the bottom of that slider bar define the width of the step in .001 inches (mils). The square at the top of each slider bar is it activate/deactivate button. Always deactivate the steps you are not using so that it will apply 100% power to that level.



The diagram above is an example of the Normal Rubber Stamp Taper Selection. You can see that there are 8 steps used to create the shoulder. The surface of the material is considered the first step and the bottom of the engraving is considered the last step. You can define as many as 16 steps but the first or the last steps are not definable because they are fixed at a power setting of 0% and 100% respectively. You can only define the parameters for the steps in between the first and last steps in which there are 14 of them. By adjusting the power setting for each step, the width in (.001) inches for each step, and the number of steps, different shoulder profiles can be created. **NOTE:** The maximum shoulder width is .056 inches.

Engraving Field Tab

Language
Select from many different languages in this drop down list. Some language changes will not take effect until the printer control panel is closed and then re-opened.

Version
Clicking Version will display a pop-up dialog box containing information on the current driver version number as well as the driver's copyright notice. If contacting technical support, it is important to have the version number of your driver available.

Start Options
Choose from either Auto Start or Manual Start in Windows 95/98/ME only. Windows 2000/XP users can only use Manual Start.

Auto Start
This enables the laser system to begin engraving as soon as you click the OK button and without having to push the start button on the control panel of the laser system. This option functions only when the laser system's one file memory mode is activated. Refer to the laser system's operations manual on how to activate one file memory mode.

CAUTION: Before using AUTO START, please ensure that your exhaust system is powered ON and your material is loaded into the machine and properly focused. Use extreme caution when using this feature because there will be very little time to stop the laser system from engraving or cutting once you have clicked OK in the driver.

Manual Start
This is the normal mode of operation of the laser system. The laser system will not start until the entire file enters into the laser system and the operator pushes the start button on the control panel.

Engraving Field

Width and Height
The page size that you enter here **MUST** match the page size in your graphics software program **EXACTLY** and it is up to the operator to enter in the correct settings. Select the metric box if metric units are desired.

NOTE: Incorrect use of this feature may cause no graphics, partial graphics, erroneous graphics, or a misaligned graphics output, relative to the application material, to occur. To avoid problems, we recommend that set it to the maximum field size of your laser system (click the Maximum Page Size button) and also set your graphics software programs page size to match.

Maximum Page Size Button
Clicking on this button restores the driver back to the default maximum page size that your model can accept.

Orientation
Orientation determines the raster direction of travel and **MUST** also match your graphics software's page orientation **EXACTLY**. The landscape mode is the **NORMAL** mode of operation and causes the laser system to raster in the left and right direction. Portrait mode (Windows 95/98/ME only) causes the laser system to raster from the front to the back of the laser system (not recommended for continuous use). **DO NOT** choose different orientation settings between your graphics software and the driver otherwise, your graphic may not print in the correct position or may not print at all because it may be inadvertently placed off the printable area of the page.

Rotary Fixture
This option is available for most models. Please refer to operations manual on how to install and use the Rotary Fixture.

Advanced Tab

Dithering
Dithering settings are used when printing grayscale or color bitmapped images such as TIF, JPG, and BMP formatted images. Since the laser system is essentially a black and white printer (black turns the laser ON and white turns the laser OFF), and if you choose the correct settings, the driver will automatically convert the grayscale or color bitmap into a 1-bit "halftoned" black and white image. This process is very similar to how newspaper photographs as well as laser printer photographs are printed. For a more detailed explanation of the terms "grayscale", "bitmap", "halftone", or "dither", please refer to the "Graphic Software Setup" section in this manual.

Halftone
This halftone pattern generator converts grayscale bitmaps into a halftoned image based on your Image Density choice in the driver.

IMAGE DENSITY	ANGLE	SHAPE	LINES PER INCH
6	45 DEGREES	ROUND	180
5	45 DEGREES	ROUND	90
4	45 DEGREES	ROUND	60
3	45 DEGREES	ROUND	45
2	45 DEGREES	ROUND	36

Error Diffusion
Unlike halftoning, error diffusion scatters the black pixels in a random pattern to represent shading. It uses the quantity of black dots instead of the size of the black dots to represent the different shades of gray. The pattern created will be dependent on the quality setting that you choose in the driver with the exception that there is no chart to reference. Higher quality settings such as 5 will produce a more densely packed, higher dot quantity pattern whereas lower resolution setting such as 2 will produce a loosely packed, lower quantity dot pattern

NOTE: DO NOT use Error Diffusion when engraving rubber stamps otherwise dots will appear in the background. Choose only Halftone.

Black and White Mode
This mode thresholds the image at 50% black. Each pixel that is greater than 50% black will be converted into white and each pixel that is 50% black or less will be converted into black. This effect is very similar to trying to duplicate a photograph using a photocopier.

Helpful Tip
Engraving grayscale bitmaps using a dithering pattern requires some practice and a bit of trial and error to achieve perfection. It also requires some knowledge of bitmap editing software. These images will visually appear different on one material as opposed to another material even if you use the same driver settings. As a rule of thumb, use an Image Density setting of 5 using halftone or diffusion pattern on harder materials such as marble, anodized aluminum or microsurfaced engraver's plastic. Use an Image Density setting of 3 using the halftone or diffusion pattern for softer materials such as wood or materials that you intend on engraving very deeply.

Print Direction

Your choices are Down or Up. The default direction is Down which begins engraving at the top of the field and finishes at the bottom. On some materials you may get better results by starting at the bottom and engraving towards the top of the field (Up). This is because the engraving smoke is being drawn towards the top of the field. On some materials engraving Down causes the smoke or debris from the engraving to be deposited onto the previously engraved surface, possibly damaging the engraved area. Experiment with the different directions using different materials and choose the best method for your application.

NOTE: The Up direction is especially useful when engraving rubber stamps and utilizing the Back Sweep Air Assist option.

Image Enhancement

These controls allow the user to "fine tune" the image which will enable the laser system to produce the highest quality, highest detailed images at high or low speeds. Image Enhancement may be used at any engraving speed and with any application material.

The following procedure may appear lengthy, but when you actually learn how to use the controls, establishing the correct parameters is easy and quick. Once you have established those parameters you can "SAVE" them in the ULS printer driver as .LAS settings and recall them when needed. Many users choose to name these saved setting according to the application material's name. Before stepping you through the procedure we must first define the parameters.

NOTE: The Image Enhancement settings are designed to work with the BLACK pen color in the printer driver. However, the other 7 pen colors of the printer driver will use the same Image Enhancement settings. Keep in mind that those settings will have a different resulting effect on if the other colors %power, %speed, and PPI are different than the black pen color's setting.

Definitions

CONTRAST: Adjusts the difference between the unengraved and engraved areas in the high density part of the graphic or where there is the most concentration of graphic pixels (in between the dotted lines) as the following diagram illustrates:

Within this effective area, using too little CONTRAST may cause some parts of the letters to appear thin, faint, fuzzy, or even non-existent. Having too much CONTRAST will cause the effective area to appear thick, bold, or over powered.

DEFINITION: Adjusts the difference between low density and the high density part of the graphic. The low density part of the graphic can be considered such as the ascenders and decenders of text, or single pixels that may be horizontally spaced far from other pixels, or the start of the graphic in the direction of the raster stroke. Refer to the following diagram:

Setting this parameter too low may cause the effective part of the graphic to appear thin, faint, fuzzy, or non-existent. Too high of a parameter will cause these objects to appear thicker, bolder, or more powered than the high density areas of the graphic.

DENSITY: Adjusts the difference between the entire unengraved and engraved areas. If the parameter is too high, then the entire engraved image may appear thick, bold or over powered. Too low of a setting may cause the image to appear thin and pixels or parts of characters may disappear altogether. The opposite effect would occur on inverted images such as white text on a black background.

TUNING: Adjusts the image so that the pixels vertically line up with each other during the left and right, bi-directional raster strokes, will line up properly. A misadjusted TUNING value will cause the image to appear double-imaged or inadvertently bolder than normal. A typical non-Image Enhanced TUNING value can be from -4 up to 0, whereas a typical Image Enhanced TUNING value generally averages around +4. Yes, TUNING will be different if you have Image Enhancements enabled or disabled. Saving the printer driver settings will also save the TUNING value.

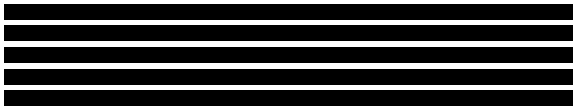
Procedure

The following procedure assumes that you have some experience working with the laser system and you have a general idea of the Power, Speed, PPI, and Image Density settings that you intend to use for the chosen application material.

In the following example, we will be engraving painted brass choosing 100% speed for good throughput, and Image Density 5 for good quality.

Step 1: Establish the nominal power setting.

In your graphics software, create a series of 5 rectangles that are about ¼ inch high and 6 inches wide as in the following diagram:



Starting with the top rectangle set the power setting to a value that you know will be too low. For example, set it to 5% power and the rest of the parameters to 100% speed, 1000 PPI, and Image Density 5. At this time, ensure that Image Enhancement is **NOT** enabled. Engrave the first rectangle at 5% power, increasing the power for each subsequent rectangle 5% finishing the series off at 25% power and note the results. What you are looking for is the **LOWEST** power setting that has the cleanest removal of material. This would be the nominal power setting. While higher than nominal settings may also produce clean engraving, it will overpower the material and may cause highly detailed engraving, unlike these rectangles, to appear too thick, bold or washed-out. If 25% is not enough power, then engrave the rectangles again, this time starting at 25% and incrementing by 5% and so on. In our particular example, we'll say that 20% power looks good but 15% appears underpowered. Since we know that this material happens to be sensitive to small power changes, we'll need to narrow it down a bit further. Engrave the rectangles once again, but this time start the top rectangle at 15% then add 1% for the next rectangle and so on until you reach 20%. The results now indicate that nominal power setting of 17% power looks as if it is the **LOWEST** power setting that produces the cleanest results at 100% Speed, 1000 PPI, and Image Density 5.

Step 2: Using text to set the CONTRAST parameter.

Type in a random line of text, using the Times New Roman font, set at 8 or 10 points in size. Make sure that the text string is at least 6 inches long and that the characters used include punctuation marks, spaces, and lower and upper case as in the following example:

Universal Laser Systems, Inc. produces the "BEST" laser systems in the world!

Engrave it with the settings determined in step one but this time ENABLE Image Enhancement and set CONTRAST to 0, DEFINITION to 0, DENSITY to 100 and the TUNING value to +4. You should expect the results to appear fuzzy, having parts of the characters missing, and overall engraving quality to be not as good as expected. This is normal. Move the line of text, slightly downward in your graphics software so that you will engrave a clean part of the material but keeping it close enough to the previous engraving so that you have something to compare it to. Keep engraving samples and adjusting the CONTRAST upwards in increments of 5 and note the results. The objective is to adjust the CONTRAST just enough to cause the high density areas of the text to be sharp and clear. Ignore the appearance of the ascenders (like quotation marks or the tops of h's) and decenders (like commas or the bottom of lower case p's) as they will appear faint and unclear. This is to be expected. **DO NOT** adjust the CONTRAST setting to try to force these to appear, we will use the DEFINITION adjustment for those. Right now, **ONLY** concentrate on the high density part of the characters. Setting CONTRAST too high can cause the characters to appear "fat" or "bold". Adjusting the CONTRAST by just one number can make a big difference in appearance so continue adjusting the setting by first incrementing in 5's until you get close, but then fine tune the setting by incrementing or decrementing by 1's until the exact setting is achieved.

***Step 3:* Adjusting DEFINITION to enhance the ascenders and decenders.**
Now, increase the DEFINITION in increments of 5 at a time until the ascenders, decenders, commas, quotation marks and any other low density area characters begin to appear. The objective is to increase the setting just enough to cause these parts of the graphic to match the appearance of the high density areas. Setting the DEFINITION too high will result in ascenders and decenders appearing too "fat" or "bold" compared to the rest of the graphic.

***Step 4:* Reducing DENSITY as needed.**
Once CONTRAST and DEFINITION have been set to the appropriate levels, the graphic may or may not appear to be "fat" or "bold". In most cases, the appearance will look great without making any more adjustments. However, if everything appears overpowered or bold, try reducing the DENSITY down from 100 in increments of 5 and note the results. If the characters begin appear to be "chunky" or appear as if pixels have been eliminated, then you have reduced it too much. Normally you can leave the DENSITY at 100. However, there may be cases where you need to reduce it. Reducing DENSITY can be very useful when the image is inverted such as white text with a black background. In this case, if the engraved area (the background) is overpowering the text (foreground) then reducing the DENSITY may help thicken the text.

TUNING

***Step 5:* Fine tuning the raster strokes.**
At this point, we are finished with Image Enhancements. Make sure that you save your settings. But your graphic may need a little more "fine tuning". The typical TUNING setting is +4 when Image Enhancement is enabled. However, this may or may not be the best setting for your system. To check this setting, you should perform this last test. Engrave the same text, with all your Image Enhancement settings but this time set the TUNING value to 0. Then move the graphic down and engrave it again with TUNING setting +1, then +2 and so forth all the way to +8. Compare each one to the other and find the one that is the sharpest and clearest. Go back and set the TUNING value to the appropriate number and SAVE your settings once again.

The Image Enhancement settings for that material are now complete. If you feel that you can "tweak" it a little more, go back to step 2 and try again, but this time start with your current Image Enhancement settings that you saved. It is not necessary to reset your nominal power setting and we recommend that you leave it the same as the value you determined in step 1.

Setting the Image Enhancement parameters using this procedure will cause all of your graphics, whether big or small, inverted or not, dense or highly detailed, to appear better than ever. We suggest that you run this procedure for all your materials and save your parameters. This may sound like a big job, but the additional productivity and engraving quality that your system is capable of producing is well worth the small amount of time spent.

NOTE: Image Enhancement will cause files to take longer to print. Since most materials do not require the use of Image Enhancement, use this feature only as needed. Also, Image Enhancement and 3D Effects cannot be selected at the same time. The printer driver will automatically notify you if you attempt to do so.

Texture
Selecting this new feature produces a "textured" or "splattered" engraving background. This helps improve the appearance of engraving large areas of material. It only works when Image Enhancement is activated.

Calculate Button
After you establish your nominal power setting for your material using the Black pen color settings, click on this button to have the printer driver automatically "estimate" your enhancement settings. The results may be useful "as-is" or may need to be adjusted. Due to the differences in laser performance, power, and material interaction with the laser beam, usage of this feature may not always yield the best results and may serve only as a starting point.

Vector Optimizer

The four available selections apply to vector output only and have no effect on raster images. Regardless of which of the following selections you choose, vectors are grouped by pen color and will always output in the color order listed in the printer driver.

OFF
Turns off this feature.

ENHANCE ONLY
The printer driver collects all the vectors from the application software and reconstructs them (so to speak) by removing start and stop points within the vector curves so that they run smoother with less jitter. It has no effect on straight, horizontal or vertical, lines

SORT ONLY
The printer driver collects all the vectors from the application software, stores them in temporary memory, sorts them, and the outputs them in the following order:

- All open path vectors are output first (not closed path vectors like circles and squares) beginning with the end point of the vector path that is closest to the current position of the focus carriage. All subsequent open vector paths are output using the same "nearest neighbor" starting point method which eliminates the random "vector hopping" that causes longer processing times.
- Closed paths will follow, beginning with the innermost closed path and ending with the outermost closed path. This is particularly useful in an elevated cutting application to prevent the outer piece from falling first. The beginning point of a closed path is automatically selected by the printer driver by the "nearest neighbor" vector path that has the steepest angle in the Y-axis direction.

ENHANCE AND SORT
This turns on both features simultaneously.

Vector Scaling

This feature allows you to calibrate vector cutting or vector engraving to your particular application. To calibrate the system, as an example, draw a precise, 5" x 5" square in your graphics software. In the printer driver, set the laser power and speed setting to vector mark (do not cut through) this square onto some scrap material. After marking, remove the material and with a precision measuring device such as a caliper, measure the square in both the horizontal (X) and vertical (Y) directions. Let's say that the measurement was 4.997"x and 4.996"y. Use the formula (desired length/measured length) and enter the result into the X-axis and Y-axis boxes respectively. In this example, the result would be X-axis = 1.0006 to 1.0000 and Y-axis = 1.0008 to 1.0000. The printer driver will scale the images larger for numbers greater than 1.0000 and will scale the image smaller for numbers less than 1.0000. After changing the numbers, repeat the marking procedure and verify that the square is scaled correctly. We used a 5" by 5" square just as an example but you can use any size object that is smaller than the maximum size of the engraving field. Using the Vector scaling feature with larger images produces more accurate results. Keep in mind that this feature **DOES NOT** scale raster images so if you combine raster and vector images in one file, the raster image may not align with your vectors. You will need to manually position your raster images in their desired position.

CAUTION: Do not attempt to use the vector-scaling feature when your graphic extends out to the absolute edge of the engraving field. You may accidentally cause the driver to attempt to print past the edge of the maximum allowable page size. Unexpected results may occur. If you use this feature, the actual allowable page size decreases by the same amount that you are attempting to offset.

Rotary Rotation

If you have purchased the optional Rotary fixture, you may need to calibrate your fixture if your application requires you to engrave or cut completely around the cylinder precisely 360 degrees. Only use this option if you completely understand and have used the Rotary Fixture in the past. If you are familiar with the operation of the Rotary Fixture and as an application you create a vector line or raster graphic that extends from the top of the page (in your graphic software) all the way to the bottom of the page, you should expect that the Rotary Fixture would rotate a full 360 degrees. If the fixture comes up short or long by a few degrees, you can compensate for this in the driver. If your application comes up short, increase the number past 1.0000 as much as you need to and run your sample again. If your application rotates past 360 degrees, then decrease the number of degrees below 1.0000 to get the ends to line up. You can calculate the exact number (refer to the Vector Scaling technique in the next paragraph) but it may be difficult to measure circumference.

Engrave these different power settings and note the LOWEST setting that cleanly engraves the material. To narrow down the precise setting further, take this setting, apply it to the middle rectangle, and subtract 2% going up and 2% going down for each rectangle. For example, let's say that we think the best setting was 20%. Take the 20% setting, apply it to the middle, and the other settings should appear as shown.

Run the test again and choose the LOWEST power setting that cleanly engraves the material. This is the power setting we will use as the correct power setting for the material while processing it at the speed and quality setting chosen. Let's say that we feel that 18% power, 100% speed and quality setting 5 is the choice we are going with. Go ahead and makes sure that you set this setting to the black color of the driver.

Step 2: Create a highly detailed image to set enhancement levels. We like to use a 10-point, Times New Roman font and create some random characters that have decenders and ascenders such as the following:

Dkjfhgnbpwiueywroeho;weurhg8o743650t92othj2'j';ldg8-9a0wwu10234jtr'3j4tn[912yun40pjm4pjk';uuut0

Engrave this sample using the settings we determined, and note the results. Pay attention to the decenders and ascenders of characters such as a "y" or a "b". If the ascenders and decenders appear normal, then no enhancements are necessary so you can stop testing and exit the procedure. If the appear faint, thin, or do not appear at all, enhancements are necessary. Proceed to the next step.

Step 3: Click on Enable and set the Low Density and High Density levels to the same as the power setting we chose (18% in this example). Run Step 2 again and observe the decenders and ascenders again. If they are still faint, increase the Low Density value by 5% and try again. Keep trying until the ascenders and decenders appear normal. If the center parts of the characters are faint, such as the vertically centered part of a "2" or the vertically centered part of a "/", then the High Density value should be increased. Increase the High Density by 5% also, and try again. Keep adjusting both settings until you balance out the ascenders and decenders, and the vertically centered part of the letters until they are equalized. Once you have found the correct setting, make sure that you save it. Now run your regular sample and note the difference. If you set enhancements correctly, your image should be sharper and have more detail. It takes some practice to get the settings just right.

NOTE: Image Enhancement will cause files to take longer to print. Since most materials do not require the use of Image Enhancement, use this feature only as needed. Also, Image Enhancement and 3D Effects cannot be selected at the same time. The printer driver will automatically notify you if you attempt to do so.

Rotary Rotation

If you have purchased the optional Rotary fixture, you may feel the need to calibrate your fixture if your application requires you to engrave or cut completely around the cylinder at least 360 degrees. Only use this option if you completely understand and have used the Rotary Fixture in the past. If you are familiar with the operation of the Rotary Fixture and as an application you create a vector line or raster graphic that extends from the top of the page (in your graphic software) all the way to the bottom of the page, you should expect that the Rotary Fixture would rotate a full 360 degrees. If the fixture comes up short or long by a few degrees, you can compensate for this in the driver. If your application comes up short, increase the number past 360 as much as you need to and run your sample again. If your application rotates past 360, then decrease the number of degrees below 360 to get the ends to line up.

Vector Scaling

This feature allows you to calibrate your vector cutting or vector engraving to your particular application. To calibrate the system, draw a precise, 5" x 5" square in your graphics software. In the printer driver, set the laser power and speed setting to vector mark (do not cut through) this square onto some scrap material. After marking, remove the material and with a precision measuring device such as a caliper, measure the square in both the horizontal (x) and vertical (y) directions. As an example, let's say that the measurement was 4.997"x and 4.996"y. Enter these measured values into the Virtual X and Virtual Y boxes respectively. This altered setting forces the printer driver to compensate for the difference. Numbers less than 5 will cause the driver to stretch the image and numbers greater than 5 will cause the driver to compress the image graphically. Repeat the marking procedure and verify that the square is scaled correctly. This procedure uses a 5" by 5" reference to scale the vectors across the entire table. Keep in mind that this feature DOES NOT scale raster images so if you combine raster and vector images in one file, the raster image may not align with your vectors. You will need to manually position your raster images in their desired position.

CAUTION: Do not attempt to use the vector-scaling feature when your graphic extends out to the absolute edge of the engraving field. You may accidentally cause the driver to attempt to print past the edge of the maximum allowable page size. Unexpected results may occur. If you use this feature, the actual allowable page size decreases by the same amount that you are attempting to offset.

View Tab

When using programs such as CorelDRAW and/or AutoCAD, there is a file preview feature that is part of the graphics program itself. Refer to your software program's manual on how to use the file preview feature. File preview can be a very useful tool. It can help you determine if you have set up your graphic properly BEFORE trying to print to the laser system. But what about AFTER you send the file to the laser system? Since the laser system itself does not have the ability to graphically display the downloaded file that has already been printed, this "View" feature, which is actually a post-viewer, was added to the driver so that you can view the last 10 files that were printed to the laser system.

The file displayed is the last file that was sent to the laser system. It shows the name of the file as well as the date and time that you printed it. In the above example, if you were to click on an object such as the "Test" graphic or the rectangle around the graphic, the color as well as the Power and Speed for that color will be displayed. Also, if there were a check mark in the "R" and "V" boxes, then the raster images as well as the vector images would be visually displayed, respectively. The "<<" and the ">>" will toggle you backwards and forward through the last 10 files. When the 11th file is printed, printer driver deletes the first file automatically, which maintains the list of the last 10 files.

Section 4

Material Settings Guide

This section provides sample driver settings and helpful hints to get started engraving and/or cutting the materials listed.

Safety

NEVER LEAVE THE LASER SYSTEM RUNNING UNATTENDED FOR ANY REASON. Exposure to the laser beam can cause ignition of combustible materials. All laser cutting and engraving should be constantly supervised.

NEVER OPERATE THE LASER SYSTEM WITHOUT A PROPERLY INSTALLED AND OPERATING EXHAUST SYSTEM. Some materials when cut or engraved can produce fumes that are hazardous in concentrated amounts. Also make sure that your room is adequately ventilated as some materials will continue to produce fumes for several minutes to possibly hours after the cutting or engraving process has been completed. Since many materials can produce toxic and possibly caustic fumes or residue, it is advisable to obtain the Material Safety Data Sheet (MSDS) from the materials manufacturer. The MSDS discloses all of the hazards when handling or processing that material. The law requires all manufacturers to provide this information to anyone who requests it.

DO NOT ENGRAVE OR CUT PVC (Polyvinylchloride) BASED MATERIALS. The fumes are extremely toxic if you inhale them. The fumes are so caustic that it can chemically destroy the metal parts of the laser system. Damage to the laser system from this type of abuse **ARE NOT** covered under warranty.

DO NOT ENGRAVE OR CUT UNCOATED METALS OR REFLECTIVE SURFACES. The laser beam can reflect off of these materials causing damage to the laser system as well as being a safety hazard. Damage to the laser system from this type of abuse **ARE NOT** covered under warranty.

- Laser engraving or cutting materials other than those described in this manual can be a safety hazard and can damage the laser system.

- Damages to the laser system due to neglect, misuse, or operator error ARE NOT covered under warranty.

- Damage to the laser system due to an inadequate or improper operating environment is considered abuse and **ARE NOT** covered under warranty.

- In no event will ULS be liable for any damages caused, in whole or in part, by customer, or for any economic loss, physical injury, lost revenue, lost profits, lost savings or other indirect, incidental, special or consequential damages incurred by any person, even if ULS has been advised of the possibility of such damages or claims.

Materials

There are many variables that can affect the cutting and engraving process such as differences in the thickness of the material, density of the material, composition of the material, and the manufacturing processes used to make the material.

Please use these settings as a guideline or starting point, in most cases these settings should work out well, but sometimes may have to be adjusted to produce desirable results.

PRINTER DRIVER SETTING TIPS

Power Setting
- Higher burns deeper. Too much power sacrifices detail. Has no effect on running time.
- Lower burns shallower. Too little power sacrifices detail. Has no effect on running time.

Speed Setting
- Higher saves time. Burns shallower and reduces detail.
- Lower increases time. Burns deeper but too deep may reduce detail.

PPI Setting
- Higher increases the burning or melting effect. Produces finer detail if speed is not too fast. Has no effect on running time and very little effect on depth.
- Lower decreases the burning or melting effect. Reduces image detail if set too low. Has no effect on running time and very little effect on depth. Very low settings are used to perforate the material.

Rule of Thumb
- Doubling the power doubles the depth and halving the power halves the depth.
- Halving the speed doubles the depth and doubling the speed halves the depth.

NOTE

When engraving very small objects, top speed cannot be achieved because acceleration and deceleration of the motion system requires time and distance. The laser system will automatically adjust itself to a maximum engraving speed that it can achieve due to the size and position of the graphic. This is why you might notice that there might be no difference in engraving time on certain graphics whether you choose 100% speed or less.

The following materials were tested with the laser system set at an Image density of 5 except where noted otherwise. The following pages will fully describe the results of these tests and will offer helpful hints when choosing materials, setting parameters, and using different techniques to provide the best laser cutting and engraving results.

Please use these settings as a guideline or starting point, in most cases these settings should work out well, but sometimes may have to be adjusted to produce desirable results.

ACRYLIC - CAST AND EXTRUDED

ACRYLIC – MIRRORED

ALUMINUM – ANODIZED

BRASS – PAINTED

CORK

CORIAN / AVONITE / FOUNTAINHEAD

DELRIN (SEAL PRESS)

GLASS / CRYSTAL

LEATHER

MARBLE

MAT BOARD

MELAMINE

PLASTIC – MICROSURFACED

RUBBER STAMPS

VINYL – SIGN (3 MIL)

WOOD / WOOD INLAY

ACRYLIC - CAST AND EXTRUDED

LIGHT RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	70	80	500	1	.001”
25	40	80	500	1	.001”
30	35	80	500	1	.001”
35	30	80	500	1	.001”
40	26	80	500	1	.001”
45	22	80	500	1	.001”
50	20	80	500	1	.001”

DEEP RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	20	500	1	.010”
25	100	33	500	1	.010”
30	100	40	500	1	.010”
35	100	47	500	1	.010”
40	100	54	500	1	.010”
45	100	60	500	1	.010”
50	100	67	500	1	.010”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	10	4.0	1000	1	.010”
25	6	4.0	1000	1	.010”
30	5	4.0	1000	1	.010”
35	4	4.0	1000	1	.010”
40	3	4.6	1000	1	.010”
45	3	5.2	1000	1	.010”
50	3	5.8	1000	1	.010”

VECTOR CUTTING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	80	.2	1000	1	.2”
25	90	.4	1000	1	.2”
30	75	.4	1000	1	.2”
35	65	.4	1000	1	.2”
40	55	.4	1000	1	.2”
45	50	.4	1000	1	.2”
50	45	.4	1000	1	.2”

COMMENTS

There are two types of acrylic available, cast and extruded. Cast turns white or frosted and extruded remains clear when engraved. Use extruded acrylic for paint filled engraving and cast for regular engraving. Cast engraves better without masking. Lightly engrave the surface to frost it with a low power setting such as the first setting listed above. If deep engraving is desired, it is necessary to mask the acrylic with transfer tape to prevent the smoke from damaging the clear surface of the acrylic. However, another problem with deep acrylic engraving is that the intense heat creates a white, crusty, deposit that accumulates along the edges of the area that was just engraved and is impossible to remove without causing damage. Engraving lightly and without masking seems to be the better all around alternative.

If only cutting acrylic, extruded works better and is less expensive than cast. The cut edges of extruded acrylic will appear to be more highly polished and clearer than cast acrylic when laser cut. When cutting acrylic, it might be necessary to remove both sides of the original masking and re-mask with transfer tape if cutting through the original masking produces flaming. The original masking is coated with wax and will not absorb water. If cutting through very thick acrylic, re-mask both sides with transfer tape and dampen the masking on both sides of the acrylic with water from a spray bottle. Elevate the acrylic off the table at least 1/2 inch, re-focus, and then proceed to cut. Elevating the acrylic will allow the beam to completely pass through the material which allows the smoke and heat to escape from underneath. If cutting directly on the engraving table, the trapped heat might cause the bottom edge of the cut to pit and distort. Re-masking and dampening with water will act as a heat sink to pull the laser heat away from the cutting area resulting in less distortion or heat effected zones (HAZ). When dampening, be sure not to leave puddles of water. Puddles of water will reduce cutting depth significantly. For the best results when combining engraving and cutting on the same piece, first engrave lightly and unmasked. Then mask with transfer tape, dampen, elevate, re-focus, and cut as a second step.

Paint filling the engraved area is possible by first masking the acrylic or leave on the original masking then engraving through the masking. Before removing the masking, brush or spray on some acrylic based or water based paint right on to the masking. When the paint is dry, remove the masking and the paint will remain in the recessed area of the engraving. Remember to use extruded acrylic when paint filling and cast acrylic when simply engraving.

WARNING
NEVER OPERATE THE LASER SYSTEM
WITHOUT CONSTANT SUPERVISION
EXPOSURE TO THE LASER BEAM MAY
CAUSE IGNITION OF COMBUSTIBLE
MATERIALS WHICH CAN CAUSE SEVERE
DAMAGE TO THE EQUIPMENT

Acrylic is extremely flammable. Do not leave the laser system unattended when cutting or engraving.

ACRYLIC - MIRRORED

LIGHT RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	75	80	500	1	.003”
25	45	80	500	1	003”
30	40	80	500	1	003”
35	35	80	500	1	003”
40	31	80	500	1	003”
45	27	80	500	1	003”
50	25	80	500	1	003”

DEEP RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	20	500	1	.010”
25	100	33	500	1	.010”
30	100	40	500	1	.010”
35	100	47	500	1	.010”
40	100	54	500	1	.010”
45	100	60	500	1	.010”
50	100	67	500	1	.010”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	12	4.0	1000	1	.010”
25	8	4.0	1000	1	.010”
30	7	4.0	1000	1	.010”
35	6	4.0	1000	1	.010”
40	5	4.6	1000	1	.010”
45	5	5.2	1000	1	.010”
50	5	5.8	1000	1	.010”

VECTOR CUTTING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	80	.2	1000	1	.2”
25	90	.4	1000	1	.2”
30	75	.4	1000	1	.2”
35	65	.4	1000	1	.2”
40	55	.4	1000	1	.2”
45	50	.4	1000	1	.2”
50	45	.4	1000	1	.2”

COMMENTS

Engraving mirrored acrylic is similar to engraving regular acrylic. The idea is to engrave through the mirrored backing enough to begin to penetrate into the acrylic. Engraving deeply will cause a crusty residue to form just like with non-mirrored acrylic. A double image will appear if engraving on the front side of the mirror. It is not necessary to mask the backside when engraving because the mirrored backing shields the acrylic from smoke damage. To cut mirrored acrylic, it might be necessary to remove all original masking, re-mask with transfer tape, and dampen the tape with water from a spray bottle. Next, place the acrylic in the laser with the mirrored surface facing upwards and elevate at least 1/2 inch above the table. The laser beam will not reflect off of the mirrored surface because it is absorbed by the acrylic first. Sometimes cutting the acrylic from the backside will cause the mirrored backing to distort and crack from the intense heat required to cut. If the combination of engraving and cutting is desired, our suggestion is to engrave the backing, unmasked, remove the acrylic, mask both sides with transfer tape, flip the acrylic over, dampen, elevate, re-focus, and cut from the front side. When paint filling the engraved area, make sure to use an acrylic-based paint or paint that does not contain acetone or alcohol, as these chemicals will crack the acrylic. Water based paints also work very well. Since the mirrored backing serves as a masking, it is not necessary to mask the backside before engraving.

WARNING
NEVER OPERATE THE LASER SYSTEM
WITHOUT CONSTANT SUPERVISION
EXPOSURE TO THE LASER BEAM MAY
CAUSE IGNITION OF COMBUSTIBLE
MATERIALS WHICH CAN CAUSE SEVERE
DAMAGE TO THE EQUIPMENT

Acrylic is extremely flammable. Do not leave the laser system unattended when cutting or engraving.

ANODIZED ALUMINUM

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	90	80	500	1	.001”
25	54	80	500	1	.001”
30	45	80	500	1	.001”
35	38	80	500	1	.001”
40	34	80	500	1	.001”
45	30	80	500	1	.001”
50	27	80	500	1	.001”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	20	4.0	1000	1	.001”
25	12	4.0	1000	1	.001”
30	10	4.0	1000	1	.001”
35	9	4.0	1000	1	.001”
40	8	4.0	1000	1	.001”
45	7	4.0	1000	1	.001”
50	6	4.0	1000	1	.001”

COMMENTS

There is a process called Laser Color Marking which enables the color filling of anodized aluminum. First, coat or spray the aluminum with a clear acrylic finish. After the finish has thoroughly dried, laser engrave the graphic onto the aluminum. Then take a water based marker, such as those found in an art supply store, and swab on the ink into the engraved area. You can actually see the ink get absorbed into the engraved area but not the unengraved area. The ink will appear lighter in color because the white engraved area tends to lighten the shade. Use a darker tint marker to compensate for the lighter effect. Wipe off the excess with a soft, lint free cloth. Finish the piece by applying another coat of clear acrylic finish and let dry.

DO NOT ATTEMPT TO ENGRAVE DEEPLY OR CUT THIS MATERIAL WITH THE LASER SYSTEM. High Power and low Speed settings can cause the laser beam to reflect off of this material which can damage the laser system and can be a safety hazard. Damage caused by this type of abuse **WILL NOT** be covered under warranty.

ENGRAVING THIS MATERIAL PRODUCES ABRASIVE PARTICLES. Clean the laser system more frequently to reduce wear and tear on the motion system components and optics. Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

BRASS - PAINTED

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	90	80	500	1	.001”
25	54	80	500	1	.001”
30	45	80	500	1	.001”
35	38	80	500	1	.001”
40	34	80	500	1	.001”
45	30	80	500	1	.001”
50	27	80	500	1	.001”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	20	4.0	1000	1	.001”
25	12	4.0	1000	1	.001”
30	10	4.0	1000	1	.001”
35	9	4.0	1000	1	.001”
40	8	4.0	1000	1	.001”
45	7	4.0	1000	1	.001”
50	6	4.0	1000	1	.001”

COMMENTS

The manufacturing process for coated brass varies from one vendor to another. Some manufacturers do not polish the brass before coating it. Since CO_2 lasers at this power level do not engrave into metals when the coating is removed, the tarnished brass underneath will have a dull appearance that will need to be polished with a brass polishing compound. This type of brass is designed for mechanical engravers that actually remove the metal when engraving which gives the brass a shine without polishing. Brass that is produced for the laser engraving industry is polished, then clear coated, and finally coated with paint. When laser engraving this type of material, adjust the power so that the laser beam removes the painted coating but not the clear coating. This will expose the polished, clear-coated brass without penetrating all the way down to the metal. Since the brass is already clear coated and polished, it will not require any cleanup after engraving nor will it ever oxidize. If too much laser power is used, the brass the clear coat will be removed and the brass underneath will be exposed to the heat of the laser beam causing instant tarnish. If polishing the brass, use a soft, non-abrasive cloth or tissue (not paper towels) and good quality brass polish. Do not rub too hard, as this will scratch the painted coating.

DO NOT ATTEMPT TO ENGRAVE DEEPLY OR CUT THIS MATERIAL WITH THE LASER SYSTEM. High Power and low Speed settings can cause the laser beam to reflect off of this material which can damage the laser system and can be a safety hazard. Damage caused by this type of abuse **WILL NOT** be covered under warranty.

CORIAN / AVONITE / FOUNTAINHEAD

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	20	500	1	.005”
25	100	33	500	1	.005”
30	100	40	500	1	.005”
35	100	47	500	1	.005”
40	100	53	500	1	.005”
45	100	60	500	1	.005”
50	100	67	500	1	.005”

DEEP RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	10	1000	1	.015”
25	100	17	1000	1	.015”
30	100	20	1000	1	.015”
35	100	23	1000	1	.015”
40	100	27	1000	1	.015”
45	100	30	1000	1	.015”
50	100	33	1000	1	.015”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	4.0	1000	1	.010”
25	60	4.0	1000	1	.010”
30	50	4.0	1000	1	.010”
35	43	4.0	1000	1	.010”
40	38	4.0	1000	1	.010”
45	33	4.0	1000	1	.010”
50	30	4.0	1000	1	.010”

COMMENTS

If paint filling, mask the material first, then engrave through the masking. In this way, when ready to paint fill, the material is already masked. Spray painting seems to be the easiest. Use the paint sparingly. Excess paint can accumulate on the edges of the engraving, which will make mask removal difficult and leave unsightly ridges. It is best to apply several lighter coats than one heavy coat of paint. Remove the masking after the paint has dried.

ENGRAVING THIS MATERIAL PRODUCES ABRASIVE PARTICLES. Clean the laser system more frequently to reduce wear and tear on the motion system components and optics. Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

CORK

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	80	30	500	1	.010”
25	80	50	500	1	.010”
30	80	60	500	1	.010”
35	80	70	500	1	.010”
40	80	80	500	1	.010”
45	80	90	500	1	.010”
50	80	100	500	1	.010”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	20	4.0	500	1	.010”
25	12	4.0	500	1	.010”
30	10	4.0	500	1	.010”
35	9	4.0	500	1	.010”
40	8	4.0	500	1	.010”
45	7	4.0	500	1	.010”
50	6	4.0	500	1	.010”

VECTOR CUTTING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	1.6	100	1	.060”
25	60	1.6	100	1	.060”
30	50	1.6	100	1	.060”
35	43	1.6	100	1	.060”
40	38	1.6	100	1	.060”
45	33	1.6	100	1	.060”
50	30	1.6	100	1	.060”

COMMENTS

Cork is not very popular for engraving but it does engrave and cut nicely. Cork is mainly used for making gaskets by vector cutting the gasket patterns.

LASER CUTTING THIS MATERIAL CAN CAUSE FLAMING AND SPARKING. Use caution when attempting to cut this material. It would be better to use a longer focal length lens to prevent the lens from being damaged during processing. **NEVER** leave the machine unattended while processing any material. Damages caused by processing any material **WILL NOT** be covered under warranty.

DELRIN (SEAL PRESS)

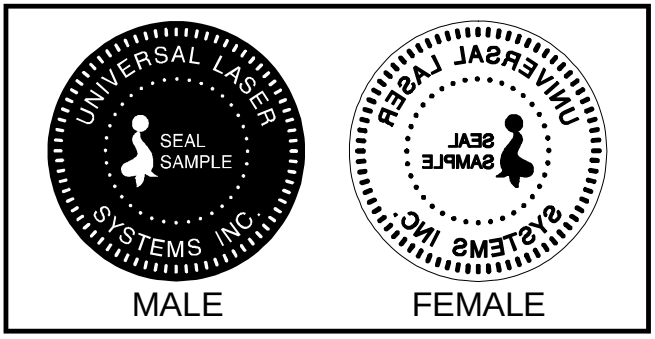
RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	18	500	1	.015”
25	100	29	500	1	.015”
30	100	35	500	1	.015”
35	100	41	500	1	.015”
40	100	47	500	1	.015”
45	100	53	500	1	.015”
50	100	58	500	1	.015”

VECTOR CUTTING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	75	1.2	200	1	.060”
25	75	2.0	200	1	.060”
30	75	2.4	200	1	.060”
35	75	2.8	200	1	.060”
40	75	3.2	200	1	.060”
45	75	3.6	200	1	.060”
50	75	4.0	200	1	.060”

COMMENTS



The laser system can be used to make dies for seal presses. It can engrave and cut out a typical Notary Seal in less than 5 minutes. Create the male with a white graphic and a black background. Mirror the image and invert it by making the background white and the graphic black. Add a .010 inch black outline to the graphic portion of the female side. This will give the greater clearance to the female side to prevent the paper from piercing through when the male side of the seal presses into the female side. Once the seal is made and fastened to the press, make several impressions onto 400 grit sandpaper to smoothen out the edges of the plastic. Make sure you turn the sandpaper over to get both sides of the seal.

LASER CUTTING THIS MATERIAL CAN CAUSE FLAMING. Use caution when attempting to cut this material. Make sure that the flame does not come in contact with any part of the laser system. **NEVER** leave the machine unattended while processing any material. Damages caused by processing any material **WILL NOT** be covered under warranty.

GLASS / CRYSTAL

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	10	300	1	.001
25	100	17	300	1	.001
30	100	20	300	1	.001
35	100	23	300	1	.001
40	100	27	300	1	.001
45	100	30	300	1	.001
50	100	33	300	1	.001

COMMENTS: Engrave at 333 DPI

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	10	2.0	300	1	.001
25	10	3.3	300	1	.001
30	10	4.0	300	1	.001
35	10	4.7	300	1	.001
40	10	5.3	300	1	.001
45	10	6.0	300	1	.001
50	10	6.7	300	1	.001

COMMENTS

Glass engraving is different from other types of engraving. A CO_2 laser cannot engrave into the glass nor can it cut glass. Instead, laser interaction with glass causes the surface of the glass to appear frosted. Sometimes, placing a piece of newspaper on the glass and dampening is with water will improve the appearance of the engraving. Another method is to apply transfer tape to the glass, wet it with water from a spray bottle, and laser engrave it. The transfer tape and water will act as a heat sink and pull the heat away from the glass as the laser system engraves it. This helps reduce chipping or flaking of the glass.

Be especially careful when engraving leaded crystal. The lead in crystal conduct heat, which can cause much more flaking or even the cracking of the crystal. Use a lower power setting to try to reduce the chance of damage. It is always good to have at least one extra piece to use as a test piece to get the right settings especially if you have never tried to engrave that material before.

ENGRAVING THIS MATERIAL PRODUCES ABRASIVE PARTICLES. Clean the laser system more frequently to reduce wear and tear on the motion system components and optics. Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

LEATHER

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	56	80	500	1	.001”
25	34	80	500	1	.001”
30	28	80	500	1	.001”
35	24	80	500	1	.001”
40	21	80	500	1	.001”
45	19	80	500	1	.001”
50	17	80	500	1	.001”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	10	4.0	500	1	.001”
25	6	4.0	500	1	.001”
30	5	4.0	500	1	.001”
35	4	4.0	500	1	.001”
40	4	4.0	500	1	.001”
45	3	4.0	500	1	.001”
50	3	4.0	500	1	.001”

VECTOR CUTTING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	50	1.0	200	1	.1”
25	50	1.7	200	1	.1”
30	50	2.0	200	1	.1”
35	50	2.3	200	1	.1”
40	50	2.7	200	1	.1”
45	50	3.0	200	1	.1”
50	50	3.3	200	1	.1”

COMMENTS

Leather is a very simple material to engrave and most types of leather engrave very well with the laser system. Simulated leather engraves well also, but the results are not as nice as with the real thing. Engraving lightly will turn the surface of the leather dark brown giving it a high contrast in appearance. Try engraving at a light power setting first. If the result is not deep enough the job can be run again over the same spot. Experiment with different depths of engraving and note the results.

MARBLE

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	28	500	1	.003”
25	100	46	500	1	.003”
30	100	55	500	1	.003”
35	100	64	500	1	.003”
40	100	73	500	1	.003”
45	100	83	500	1	.003”
50	100	92	500	1	.003”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	40	4.0	500	1	.003”
25	24	4.0	500	1	.003”
30	20	4.0	500	1	.003”
35	17	4.0	500	1	.003”
40	15	4.0	500	1	.003”
45	13	4.0	500	1	.003”
50	12	4.0	500	1	.003”

COMMENTS

Most marble and polished stones will turn white when engraved. Masking is not necessary and light engraving works out better than heavy and deep engraving. Engraving deeply will cause a highly detailed image to appear washed out. The objective is to engrave deep enough to turn the marble white and provide a good contrast. Too much power can also cause the material to discolor and turn brown as if it were burned. Photographs look great when engraved on marble, especially darker marbles where the whiteness of the engraving really stands out. Avoid using marble that is very textured looking. The texture washes out the details of the engraving. Try to use uniformly colored marble and related stones. Marble can also be paint filled by using a wax based paint. Rub the paint on with a fingertip, let dry and then buff with a soft cloth. The paint will only adhere to the engraved surface and not the surrounding areas.

ENGRAVING THIS MATERIAL PRODUCES ABRASIVE PARTICLES. Clean the laser system more frequently to reduce wear and tear on the motion system components and optics. Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

MAT BOARD

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	90	80	250	1	.005”
25	54	80	250	1	.005”
30	45	80	250	1	.005”
35	39	80	250	1	.005”
40	34	80	250	1	.005”
45	30	80	250	1	.005”
50	27	80	250	1	.005”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	40	4.0	250	1	.005”
25	24	4.0	250	1	.005”
30	20	4.0	250	1	.005”
35	17	4.0	250	1	.005”
40	15	4.0	250	1	.005”
45	13	4.0	250	1	.005”
50	12	4.0	250	1	.005”

VECTOR CUTTING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	3.2	200	1	.050”
25	60	3.2	200	1	.050”
30	50	3.2	200	1	.050”
35	43	3.2	200	1	.050”
40	38	3.2	200	1	.050”
45	33	3.2	200	1	.050”
50	30	3.2	200	1	.050”

COMMENTS

Mat board (thick cardboard) is an excellent material to use for architectural modeling and for picture framing. It cuts and engraves very neatly and cleanly. It comes in a variety of shades and colors. Patterns can be engraved on the surface with a power setting for light engraving which just breaks through the very thin top layer and exposes the lighter colored underlying substrate. When engraving, a low PPI setting is used to prevent overexposure of the underlying substrate material, which causes excessive dark discoloration. Masking is not necessary on the top surface when engraving. When cutting, both sides might need to be masked and the material elevated above the engraving table. This will produce an extremely clean edge on both sides of the material.

MELAMINE - STANDARD ENGRAVING

LIGHT RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	20	500	1	.015”
25	100	33	500	1	.015”
30	100	40	500	1	.015”
35	100	47	500	1	.015”
40	100	53	500	1	.015”
45	100	60	500	1	.015”
50	100	67	500	1	.015”

DEEP RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	14	500	1	.020”
25	100	23	500	1	.020”
30	100	28	500	1	.020”
35	100	33	500	1	.020”
40	100	37	500	1	.020”
45	100	42	500	1	.020”
50	100	47	500	1	.020”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	40	4.0	500	1	.010”
25	24	4.0	500	1	.010”
30	20	4.0	500	1	.010”
35	17	4.0	500	1	.010”
40	15	4.0	500	1	.010”
45	13	4.0	500	1	.010”
50	12	4.0	500	1	.010”

COMMENTS

Engraving melamine is very similar to engraving regular wood with the added benefit of a consistent surface finish and uniform base material composition. Unlike regular wood that has grain patterns and density variations, melamine, when laser engraved, produces a flat and even engraved area. This characteristic gives this material superior engraving and paint filling qualities. Masking can be used if desired but it is just as easy to spray the engraved area with water and wipe down with a chamois cloth to remove the smoke residue. Since the top surface material is consistent in texture and color, engraving photographs or highly detailed images produces exceptional results. Refer to the next example on engraving photographs and/or ClipArt.

MELAMINE - PHOTO/CLIPART ENGRAVING

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	80	30	500	1	.008”
25	80	50	500	1	.008”
30	80	60	500	1	.008”
35	80	70	500	1	.008”
40	80	80	500	1	.008”
45	80	90	500	1	.008”
50	80	100	500	1	.008”

COMMENTS: Engrave unmasked. Use a resolution of 500 DPI.

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	80	15	500	1	.008”
25	80	25	500	1	.008”
30	80	30	500	1	.008”
35	80	35	500	1	.008”
40	80	40	500	1	.008”
45	80	45	500	1	.008”
50	80	50	500	1	.008”

COMMENTS: Engrave unmasked. Use a resolution of 250 DPI.

COMMENTS

Engraving photographs can be challenging at first but becomes easier once there is an understanding of what to look for and how to achieve the desired results. In an image processing software, scan the image in at 300 DPI. Adjust the brightness and the contrasts to brighten the light colors and darken the dark colors. The photo might look better by using a sharpening filter to sharpen up the image slightly. The next step is to select a halftone pattern. Usually, imaging software gives the choice of using different halftone patterns including frequency of lines per inch and pattern angles. Use a line frequency above 20 and below 100. The size of the dots decreases as the line frequency increases. Experiment to see which pattern looks the best. Big dots look good on some materials and small dots look better on others. If it is not possible to assign a halftone pattern in the imaging software, the printer driver will automatically default to a predetermined pattern based on **RESOLUTION**. When using the Clipart mode switch, which prints all Clipart or drawings as grayscale bitmaps, use the same parameters and techniques as for engraving photographs. Please refer to Section 3 about using predefined halftone screens in the driver or creating custom ones.

PLASTIC - ENGRAVERS MICROSURFACED

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	70	80	500	1	.003”
25	40	80	500	1	.003”
30	35	80	500	1	.003”
35	30	80	500	1	.003”
40	26	80	500	1	.003”
45	22	80	500	1	.003”
50	20	80	500	1	.003”

VECTOR CUTTING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	1.2	150	1	.060”
25	60	1.2	150	1	.060”
30	50	1.2	150	1	.060”
35	43	1.2	150	1	.060”
40	38	1.2	150	1	.060”
45	33	1.2	150	1	.060”
50	30	1.2	150	1	.060”

COMMENTS

Laser engraveable plastic comes in many different colors, thickness, coatings, and surface textures. Most engravers plastic will engrave and cut well with the laser system as long as it is microsurfaced and formulated for laser engraving. Removal of large amounts of material will warp the plastic. You might need to tape it down or hold it down flat somehow to prevent it from curling as you engrave. Since these plastics have low melting point, a low PPI setting is used when cutting to reduce the possibility of melting. Masking and dampening with water also helps to reduce melting and keeps the plastic clear of smoke residue. Always remove the original clear masking from the plastic because it does not react well with the laser. Since there are so many types of engravers plastics, the only true way to find out if a particular brand and type will work well with the laser is to experiment. Use these power settings as a guideline for experimentation and adjust as necessary. Thicker top coated plastics are not recommended because it requires too much power to remove the material and the large amount of smoke created usually stains the substrate.

WARNING
NEVER OPERATE THE LASER SYSTEM WITHOUT CONSTANT SUPERVISION
EXPOSURE TO THE LASER BEAM MAY CAUSE IGNITION OF COMBUSTIBLE MATERIALS WHICH CAN CAUSE SEVERE DAMAGE TO THE EQUIPMENT

LASER ENGRAVING OR CUTTING PLASTIC CAN IGNITE THE MATERIAL. **Never leave the laser system running unattended for any reason.**

RUBBER STAMPS

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10 (Not recommended)	N/A	N/A	N/A	N/A	N/A
25	100	13	500	1	.030”
30	100	16	500	1	.030”
35	100	19	500	1	.030”
40	100	21	500	1	.030”
45	100	24	500	1	.030”
50	100	27	500	1	.030”

PERFORATED VECTOR CUTTING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10 (Not recommended)	N/A	N/A	N/A	N/A	N/A
25	60	1.3	90	1	.040”
30	60	1.6	90	1	.040”
35	60	1.9	90	1	.040”
40	60	2.1	90	1	.040”
45	60	2.4	90	1	.040”
50	60	2.7	90	1	.040”

COMMENTS

To create a rubber stamp, use the “3D Effects” tab in the driver (Section 3). In the above example, only one pass is necessary to achieve a deeply engraved rubber stamp. When cutting out the rubber stamp, we recommend using a very low PPI setting. This setting spreads the laser pulses far enough apart that they just touch at the edges. The result is a perforated cut that allows the rubber stamp to remain attached to the entire sheet but easily removed by simply tearing it off. The advantage to this is that the possibility of distortion or melting while cutting is virtually eliminated and the entire sheet of rubber stamps can be removed from the machine at one time instead of having to pick them up one by one.

- LASER ENGRAVING OR CUTTING RUBBER CAN IGNITE THE MATERIAL. **Never leave the laser system running unattended for any reason.**
- **LASER ENGRAVING OR CUTTING RUBBER CAN PRODUCE FOUL ODORS.** You might need to particulate filter and/or odor filter your exhaust depending on your environment, installation location, and/or your local air quality control laws.
- **LASER ENGRAVING OR CUTTING RUBBER PRODUCES ABRASIVE DUST.** Clean the laser system more frequently to reduce wear and tear on the motion system components and optics. Damage to the laser system from inadequate or insufficient maintenance **WILL NOT** be covered under warranty.

SIGN VINYL

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	15	500	1	.015”
25	100	25	500	1	.015”
30	100	30	500	1	.015”
35	100	35	500	1	.015”
40	100	40	500	1	.015”
45	100	45	500	1	.015”
50	100	50	500	1	.015”

VECTOR CUTTING (KISS CUT)

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	3	2.0	500	1	.003”
25	5	3.3	500	1	.003”
30	5	4.0	500	1	.003”
35	5	4.7	500	1	.003”
40	5	5.3	500	1	.003”
45	5	6.0	500	1	.003”
50	5	6.7	500	1	.003”

COMMENTS

Sign vinyl comes in a wide variety of colors, patterns, thickness, finishes, and reflectivity. There are a few methods for using sign vinyl with the laser system. One method is to vector cut (unmasked) through the vinyl but not through the backing. This technique provides results equivalent to a vinyl cutter machine. Once the vinyl has been cut, remove the excess vinyl, apply transfer tape and use a squeegee to remove trapped air bubbles. The transfer tape can then be lifted off and the vinyl lettering or objects that were vector cut will stick to the transfer tape and maintain their correct spacing with respect to each other. Now apply the tape to the desired surface and squeegee, peel off the transfer tape, and the lettering will remain adhered to the surface. The other method is to apply a piece of vinyl to the desired surface (unmasked) and adjust the laser power so as to cut through the vinyl without engraving into the material below. Another example is to cover the entire surface of a wooden plaque with vinyl, use a squeegee to remove all air bubbles, and then mask the entire surface with transfer tape to protect the vinyl from smoke damage. In the graphics software, color the background black and place white filled text on top of the colored background. Since the laser system does not engrave white filled objects, the background will be engraved and the lettering will be untouched. Peel off the excess vinyl and transfer tape to reveal the final product.

MOST SIGN VINYL IS MADE FROM PVC (Polyvinylchloride). DO NOT USE PVC BASED VINYL. The fumes are extremely toxic if you inhale them. The fumes are also caustic and can chemically destroy the metal parts of the laser system. Damage to the laser system from this type of abuse **WILL NOT** be covered under warranty.

WOOD

RASTER ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	15	500	1	.020”
25	100	33	500	1	.020”
30	100	40	500	1	.020”
35	100	47	500	1	.020”
40	100	53	500	1	.020”
45	100	60	500	1	.020”
50	100	67	500	1	.020”

VECTOR ENGRAVING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	100	2.5	500	1	.030”
25	80	4.2	500	1	.030”
30	80	5.0	500	1	.030”
35	80	5.8	500	1	.030”
40	80	6.7	500	1	.030”
45	80	7.5	500	1	.030”
50	80	8.3	500	1	.030”

VECTOR CUTTING

LASER WATTAGE	POWER	SPEED	PPI	PASS	DEPTH
10	60	0.8	250	1	.125”
25	50	1.3	250	1	.125”
30	50	1.6	250	1	.125”
35	50	1.9	250	1	.125”
40	50	2.1	250	1	.125”
45	50	2.4	250	1	.125”
50	50	2.7	250	1	.125”

COMMENTS

When engraving wood with a laser, a brown, maple syrup like residue will deposit on the surface of the wood. This is normal and impossible to eliminate by **POWER**, **SPEED**, or **PPI** changes. More residue will be present when engraving deeper and/or slower. This residue washes off with water and a sponge. We recommend using a kitchen sponge with a nylon string mesh wrapped around it. Dampen the sponge and wipe off the residue. A damp chamois cloth works well also. Do not use paper towels or a regular sponge because these materials will get lodged in the engraved area when wiping and are extremely difficult to remove. A method to avoid cleanup is to mask the wood with transfer tape and peel off the tape after engraving. If desired, after engraving and before peeling off the tape, spray paint can be applied to color fill the engraved areas. After the paint dries, peel off the tape. If an intricate drawing has been engraved and there are many small pieces of tape to remove, it may be easier to flood the masking, after engraving, with water. This will loosen the tape and it can be easily removed by rubbing it off by hand. In the vector cutting example, the wood was elevated from the table to let smoke and heat escape from underneath. If elevating the wood, mask and/or dampen the bottom side of the wood very lightly and the water acts as a heat sink to prevent the underside from flaming and charring. Elevating the wood also helps to determine whether the laser has passed completely through since the cut pieces will fall through to the table when cutting is finished. If raising the wood, set up the drawing so that the inner pieces of the drawing are cut first, otherwise pieces may fall through at the wrong time.

Not all wood finishes are created equal. When ordering wood from a supplier, be sure to specify that it is being used for laser engraving. Some finishes cannot handle the heat from the laser and will bubble, blister, and possibly turn white. For engraving softer woods such as pine or balsa, reduce the power settings to acquire the best depth. Engraving too deep on soft woods will reduce quality. Every type of wood will engrave differently. It is better to engrave woods that are finished. If engraving unfinished wood and it is not masked with transfer tape, the smoke residue tends to embed in the wood and is impossible to remove without sanding. To prevent this, mask all unfinished wood with transfer tape.

WOOD INLAYS - VENEERS

Create a drawing with no outlines, only filled areas. Engrave the filled areas almost as deep as the thickness of the veneer (usually about .003 inches (.1 mm) or less). With some water and a nylon brush, remove all residue from the engraved area. When cutting veneers make sure they are lying absolutely flat. In the drawing, give the objects an outline of .001 inches (.1 mm) and remove the fill. Adjust the power so that there is just enough power to cut completely through the veneer. Overpowering the cut will cause too much material removal and the fit will not be snug. Some software programs allow outline offsetting to compensate for the thickness of the beam called contouring. Usually, a contour to the outside of the vector line of .006 inches provides a tight fit. Remember if using more power to cut through the veneer, compensate for the thicker width of the laser cut by contouring a little further to the outside.

Another method is to first create your graphic and fill it with the color black. Then give it a white outline of .012 inches (.3 mm). If you look at the graphic when you add the outline, you will see that it appears to shrink. Now raster engrave the graphic to a depth slightly shallower than the thickness of the veneer. When the engraving is finished, place the veneer into the laser system. Remove the black fill and change the outline to a different color. Cut out the veneer with the laser system, add glue to the veneer, and apply the veneer into the engraved area of the other piece of wood and let dry. After the glue has thoroughly dried, sand the veneer until it is flush with the base wood. A good veneer to use is one with an adhesive backing. Once cut, place the veneer into its proper place on the engraved wood block and with a clothes iron, and iron the veneer into the engraved wood. This melts the glue and causes the veneer to stick to the engraved area. Finish the wood as you desire and the finished product will look fantastic. The veneer can now be sanded flush with the surface and a finish coat applied.

LASER ENGRAVING OR CUTTING WOOD CAN IGNITE THE MATERIAL. **Never leave the laser system running unattended for any reason.**